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THE AMERICAN GAS LIGHT JOURNAL

REDMANKRENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LIII.—No. 2. Whole No. 788. | NEW YORK, MONDAY, JULY 14, 1890. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, N.Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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BRIEFLY TOLD.

THE TEACHINGS OF THE FIRST FIVE MONTHS OF 1890.—That which was predicted by us last January, when we contended that the gas makers were entering on a twelvemonth that would result in a greater extension of their business than had been experienced for some years back has come to pass. Further, it is our pleasure to be in position to say that the advance so far recorded is very much ahead of what we looked for. We are in receipt of output figures from forty different points, which represent a total sendout of many thousand millions cubic feet, and the gain shown by a comparison with the corresponding sendout of the first five months of 1889 is an average increase of 13.2 per cent.—a very satisfactory showing, indeed. It should also be borne in mind that this percentage cannot be held to give more than a fair indication of the increase in business, since it does not embrace the months (June, July and August) when the sendout on account of gas cooking uses would be most greatly influenced. The gain in the latter respect, however, will enter into the summary for the year; and we have no doubt that even those who are most sanguine over the development of the gas industry will be surprised at the results achieved. Looked at from any standpoint, the history of the first five months of the current year is a record of marvellous progress in the gas industry of the country.

THE FORT WAYNE ELECTRIC COMPANY SUCCESSFUL.—Mr. Knight, of Fort Wayne, who represents the home establishment of the Fort Wayne Electric Company—and it is needless to add that Knight is about as clever a representative as the Company could possibly have—paid us a visit last week, on which occasion he was in his happiest vein. His vivacity had good reason for existence, in that he had just closed a contract with the American Electric Company, of Kansas City, Mo., which calls for the installation, in Kansas City, of an arc light plant, rated to maintain 600 (2,000 candle power) lamps, on the Wood system, which is controlled by the Fort Wayne Electric Company. The contract was awarded only after a most careful and thorough examination into the merits of all the leading arc systems on the market. Is it any wonder, then, that Mr. Knight was in sprightly mood?

AN ADDENDUM TO THE THOMPSON PAPER, ON THE CLAUS PROCESS.—In our issue for last week (July 7, page 3) we published an article on the "Claus Process" by Mr. George Tredway Thompson, of St. Louis. We had hoped to print this article at an earlier date, but the MSS. was held back by Mr. Thompson in the hope that he might be enabled to speak more specifically as to the present working of the Claus system at the Belfast (Ireland) gas works. Owing to delay in the transmission of the foreign mails, the desired information came to hand at a period too late for incorporation in the Thompson paper; but the defect is now remedied in the publication of the following, recently at hand from Mr. Thompson:

"A recent letter from Mr. James Stelfox, Engineer of the Belfast Corporation, contains the following interesting remarks: "'We are not, at this moment, working the Claus Process, but the assumption that we have given it up is quite a mistake. As a matter of fact, we succeed-

ed in the thorough purification of our gas for a period of over two months, during which upwards of 8,000 tons of coal were carbonized. Of course, the gas was passed through our own purifiers afterward, as a check; but the experiments were made at the outlet of the Claus Process, and during the period mentioned only on one occasion was there any foul test; and that was owing to the negligence of the man in charge. The reason of our stopping was the complete breakdown of our pumps. I have been obliged to lay them aside, and have fixed a complete new set, supplied by the Worthington Company, New York. These are all fixed, and I only await the arrival of a new still, to be supplied by Messrs. C. & W. Walker, to re-commence operations. I have every hope that when we do again commence we shall thoroughly achieve the object of our experiments.'"

SOME HINTS FROM COLUMBUS, GA.—The annual meeting of the Gas Light Company, of Columbus, Ga., was a most harmonious one, which is not to be wondered at when it is known that the balance sheets for the year disclosed a good round sum to the credit of the working for the twelvemonth. Superintendent Jenkins came in for a round of congratulation, which was fairly earned by that capable and painstaking officer, whose best efforts are always at the call of the Company and its patrons. To show that he is up with the times we have only to give the following analyses of some of the figures in his report:

Gas sold in first six months of 1890	6,337,800 cu. ft.
" " " " 1889.....	5,967,200 "
Increase....	370,600 cu. ft.

—or 6¼ per cent. This gain is all the more pronounced from the fact that the Company has had no street lamps since February 1st, and is experiencing sharp competition from the local electric light company. The decrease in *cost* of gas *sold* figures out at 12.63 per cent. for the 6 months. The number of consumers on July 1st, 1890, was 541; on the same date, 1889, the number was 489—an increase of 59, or 14.25 per cent. The annual election resulted in the selection of the following officers: President, T. E. Blanchard; Secretary and Treasury, T. D. Huff; Superintendent, E. H. Jenkins. Directors, D. P. Dozier, T. E. Blanchard, D. F. Wilcox, J. B. Holst and W. L. Clark. An animated discussion took place in respect to the matter of making a special effort to popularize the use of gas for cooking and fuel purposes, and it was finally decided to make a special rate ($1.25 per 1,000 cubic feet) for such use, provided the quantity so used in each instance amounts to 1,000 cubic feet or over per month. That liberal policy ought to have the desired effect.

A CORRECTION.—In the discussion that followed the reading of the paper by Mr. Printz—"Wrought Iron, Cast Iron or Steel—which is the Best Material for Street Mains?"—at the St. Louis Meeting of the Western Gas Association—Mr. Wm. Tracy, of Alton, Ills., is quoted (June 30, p. 916, second col., first paragraph) as saying: "I have used cement joints for years. I use four parts of cement to one of lead. * * *." What Mr. Tracy did say was: "I have used cement joints for years. I use four *joints* of cement and one of lead for expansion," etc.

THE BOARD OF HEALTH CONDEMNS THE STEAM HEATING COMPANY'S PIPING SYSTEM.—The authorities of New York are, as they certainly ought to be, pretty well stirred up over the recent street upheavals in lower Broadway, and it now looks as if the Steam Company is in for a notice that it must repair its mains, or go. Following the mandate of the Board of Public Works, and the presentment of the June Grand Jury, we are now treated to a report made by a corps of experts commissioned by the Board of Health to look into the causes of the many recent and violent explosions that have been traced to the manholes of the Subway and Steam Companies in and about Broadway and Fulton streets. The examiners made an extensive series of temperature tests of the manholes and of the soils close to the pipes and conduits of the Steam Company and the Croton water mains, etc., and the readings show an astonishing state of affairs. The temperature (normally) of the subway manholes is shown to run from 70° to 76°, but in the Steam Company's manholes the temperature attains, and not infrequently, a maximum of 162°. The temperature of the Croton water as it enters buildings in lower Broadway in pipes located a few feet from the steam pipes is often at 120°, while the normal temperature should not, and does not, in situations unaffected by proximity to the steam pipes, exceed 76°. The temperature in vaults under the sidewalks in lower Broadway at points where the steam mains pierce the roadbed at the distance of a few feet is frequently at 170°. It is presumed, in consequence of this presentation by its experts, that the Board of Health will order the Steam Company to make special alterations in its piping system, in accordance with plans formulated by the Board. It is regrettable that the experts did not make a series of temperature tests of the gases in the conduits passing through the points examined.

THE RYDE MEETING OF THE BRITISH GAS INSTITUTE.—The success of the 27th annual meeting of the Gas Institute (held at the Town Hall, Ryde, June 17 to 19), under the Presidency of Geo. Garnett, Esq., evidences fully the fact that the great body of the membership of the Institute has that spirit of fealty which counts for much in times of dissension. At any rate the proceedings of this year prove that the old Institute is to grow in years and usefulness despite the confusion and secession of a twelvemonth ago; and that is matter for hearty congratulation, surely. The paper list was an excellent one, but the discussions on the subjects presented were not as voluminous or interesting as some that have been reported at other gatherings. The technical portion of the meeting, however, was most creditable to the Institute, and, in accordance with our custom, we shall place before our readers in due time the papers that were read. The Birmingham Medal was most appropriately awarded to Mr. T. Newbigging, of Manchester, "in consideration of work he had successfully carried out not only in various parts of England but in South America, Africa and on the Continent of Europe." The other prizes were thus awarded: £10 to Mr. W. A. Valon, for his paper of a year ago on the use of oxygen in connection with the purification of gas; £7 to Mr. Geo. Anderson; £3 to Mr. Norton H. Humphrys (our Special English Correspondent), for his contributions to the scientific periodicals, and for his practical work in the laboratory. The meeting was favored with fine weather, which added greatly to the enjoyment of the elaborate outing programme that had been prepared. Mr. Joseph Hepworth (of Carlisle) was chosen President, and Messrs. W. A. Valon and Harrison Veevers were named Vice-Presidents. The next meeting will be held at Carlisle.

FIXING ELECTRIC LIGHT RATES, SPENCER, MASS.—The Spencer Gas and Electric Light Company has agreed to accept 30.35 cents per night for each electric (1200-candle power) arc supplied the town, on the basis of a table of lighting "from dark until midnight." This price is the result of an "average" of the rates paid to the remaining nine towns in Worcester county that maintain 1200-candle power electric arcs.

AN ODD EXPLOSION.—A contemporary notes that about a fortnight ago, shortly after the lights had been lit, a cat in an Atlanta (Ga.) drug store overturned a gallon demijohn containing a quantity of ether. The vapor of the latter was fired by a gas light, and the resulting explosion, though not of great force, was sufficient to disarrange the contents of many neatly-arranged shelves.

THE Garland Gas Light Company, of Hot Springs, Ark., is about to change its system of manufacture to water gas, having contracted with the National Gas Light and Fuel Company for a Springer apparatus, rated to make 240,000 cubic feet per diem. The same contractors will also erect an apparatus for the Kenilworth Company, a new gas enterprise incorporated for Kenilworth, a rapidly-growing suburban district of Chicago.

The Market for Gas Securities.

The feature in the city gas share market is the continued strength displayed by Mutual shares; also in the instance of the Equitable. The former stock cannot be purchased for less than 125, if at that. The Company's earnings are steadily increasing, and the Directors have (on 10th inst.) ordered an increase in the half-yearly dividend of ½ per cent., which means that the immediate annual return is to be raised from 4 to 5 per cent. The Equitable Company's earnings are responsible for the increase in its stock values. Consolidated shows no change, and Brooklyn shares are about as before. A despatch to the *Tribune* (July 10) is as follows: "All the $50,000,000 of stock of the American Gas Investment Company, one half of which was to have been placed in England and the remainder in this country, will now be disposed of in the United States. The reason for the change in the placing of the stock is said to be due to the bickerings of the two factions in London, each of which sought to control the stock allotted to the English capitalists. * * * The leading projectors of the Company, all well-known capitalists of this city (Philadelphia), who had already subscribed, held a conference, and all agreed to double their subscriptions. * * *." The Milwaukee Company has declared a dividend of 5 per cent., and will make an addition to its capital, which will bring the latter up to $1,140,000. The present amount is $950,000.

[A Paper Read Before the British Gas Institute.]

Difficulties in Tank Construction.

By Mr. THOS. NEWBIGGING.

A narrative of difficulties encountered and overcome is always interesting, besides being instructive and useful. Having this in mind, I thought that a profitable half hour might be spent in recounting the difficulties I had lately to contend with in the construction of a concrete tank. The story is a simple, straightforward one. I tell it more for the encouragement of young engineers, who in their work may have difficulties to contend with, than from any novelty of situation it contains. It will probably awaken reminiscences of similar troubles experienced by others; and it should lead to a discussion of a valuable character on this important branch of engineering practice.

The gas works on the premises of which the structure had to be built are situated on what I might desiginate the "flats," or low ground, not far distant from the present estuary of one of the largest Lancashire rivers. Without doubt, at one time (how long ago it is not possible to say) the whole of the land hereabouts was under the water of the same estuary, which has gradually become contracted to its present width. The ground in the locality is, geologically speaking, of comparatively recent formation, consisting first of 18 inches of soil, succeeded by a layer of peaty vegetable deposit 10 feet in thickness. This is just like a thick carpet, springy to the tread, and saturated with water, which is retained in its interstices precisely in the way that water is absorbed and held by a sponge. The fact that it retained the water was so far advantageous to the work, inasmuch that at no time was much trouble experienced with the presence of any large influx of water into the excavation. Underneath this layer of vegetable matter was a bed of blue silt, locally called "white ore," 18 feet thick. On reaching this our difficulties began; for no sooner was it laid bare and exposed to atmospheric influences, than it softened and ran like melted butter. But this is a digression from the order of my story.

On being consulted by the Gas Committee, the question arose as to whether a cast iron tank standing partially above the ground level, or whether a brick or concrete tank wholly in the ground, should be adopted. I had previously glanced at the situation, and scarcely liked the idea of an iron tank. There was already, on another part of the site, a cast iron tank, which had contracted a curious habit—an objectionable habit in a tank—of floating about, or tilting over from one side to the other. At one time it would be 3 or 4 inches out of level to the right; at another time it had changed its mind and stood as level as a die. But the latter was only a passing mood; for, on examining it a little later, it was found to have lurched over several inches to the left. Looked at from a philosophical point of view, the phenomena which this tank exhibited were interesting as a study. A tilting tank, however, as you will all admit, is not desirable from a gas manager's point of view, and especially if it happens, as was the case here, to be the only tank and holder on the premises. As a curiosity, it was everything that could be desired; but its antics were a sore grief to the manager, and the fear of a mishap was always present to his mind. It became his "Old Man of the Sea." He looked at it askance at intervals during the day; and on retiring to rest at night, he would dream that it had jumped on him as he lay asleep, and held him in its clutches like a nightmare. The fact is, the structure rested on the spongy, peaty layer which I have described; and hence its unstable condition and erractic movements.

Before making up my mind as to what class of tank should be adopted, I had borings made of the ground; and after piercing through 28 feet of the soft strata mentioned, we reached a bed of solid clay. Thereupon, my recommendation was that a concrete tank, 28 feet 6 inches in finished depth, should be constructed. The Committee, like sensible men, accepted my recommendation, and empowered me to prepare the design, and see to the work being carried out.

The contract having been made, the first thing was to sink a trench 12 feet wide all round the circumference and close-timber both sides of the excavation. This was done to about half the depth only, as, from the nature of the ground, it was considered unsafe to go to the full depth at once. The vertical shoring timbers were 7 inches wide by 3 inches thick; the double walling-pieces, 3 feet apart, were 11 inches by 3 inches; and the struts were 9 inches by 6 inches in cross section. To prevent the blue silt from oozing through between the vertical timbers, a quantity of hay was used in caulking the joints.

Seeing, as I have explained, that it would be risky to open the trench to the bottom all the way round, I decided that the wall should be put in in sections. This was accordingly done. A sixth part of the circumference was opened up right down the full depth. The concrete was built up to a height of 12 feet. Then the next section was similarly dealt with, and so on till the circle was completed. Every section as it rose was carefully shored from the ground left in the center, and backed with sharp sand, that settled down like a wedge behind the wall.

It might seem an objectionable thing to thus build up the concrete wall in sections. So it was, unless great care had been exercised. In the first place, the wall was not sufficiently strong in itself (the circle not being completed) to resist the pressure of the semi-liquid and moving mass behind it. It was only the careful timbering of the wall behind, and the shoring of it in front from the center mound, that admitted of its being done. Again, in adopting this method of construction, there is always danger of unequal settlement in the different sections, resulting in cracks and fissures. This was avoided by taking care to thoroughly "pun" or pound the layers of concrete as they were deposited. When the complete circle was thus finished in sections to a depth of 12 feet, the remainder of the wall, to its full height, was put in by adding continuous layers all round. At certain points, where there was reason to apprehend danger in drawing the shoring timbers from behind the wall, these were left in position. The value of this timber not recovered was £230. The ground inside was then removed, the bottom concreted, and the whole of the inner surface coated ½-inch thick with a rendering composed of equal parts of Portland cement and sand, afterwards skimmed with neat cement.

The poor contractor, I am sorry to say, lost several hundred pounds in carrying out the work. And here I may mention the fact that, in all my experience in masonry tank building, I have never known the contractor to make money out of it. I account for it largely in this way: When work of this kind is advertised, there are always a number of new men—men new to the work of tank construction—ready to tender. These, being without experience of the risks and difficulties, put in a low figure; and it being the rule to accept the lowest tender, providing the person tendering has anything of a reputation, the contract terminates in a loss.

The clerk of the works whom I appointed to see to the proper carrying out of the contract was a plain practical man. I do not think he knew anything of the differential calculus, even if he had ever heard of it; but the theory of strains seemed to be a part of his constitution. Squaring the circle is admitted to be a most difficult operation, and one that tries the capabilities of the most ingenious mathematicians; but that he squared that particular circle, I am prepared to vouch with all my power. He was a veritable Mark Tapley of a works clerk. The greater the difficulties, the higher his spirits became, and the higher his hopes ascended. A man of that kind is simply invaluable to an engineer. Some clerks of works I have known (though this remark does not apply to any of mine, I am happy to say) take a delight in magnifying troubles. They look only at the dark side of things; and the expression of their countenance at any slight mishap is enough to drive one into despair. Not so my man. The more harassing the difficulty, the pleasanter he looked. His "bright smile haunts me still." He lodged in a house within half a stone's-throw of the work; and, as he told me himself, he used to take pleasure in lying awake at night listening to the creaking and straining of the timbers in the trench. Every now and then a crack as of a rifle shot, caused by the splintering of the tough wood, woke the echoes of the night; but he knew that the struts were there and doing their duty, and that this was only their way of letting him know that they were "on the job." He had other excellent traits in his line; for he always talked of cement, concrete, puddle, and bricks and mortar, as though they were his brothers and sisters.

Meanwhile, as the work proceeded, our old acquaintance the cast iron tank, contiguous to the new work, was continuing its absurb vagaries, only more so, because there was a slackening of the spongy foundations underneath it. First it lurched over to one side, then over to the other. I was strongly inclined to chain it to the spot and prevent its running away with the holder; but Mark Tapley promised to keep a close watch upon it. A dancing dervish of a tank is not desirable, however unique its performance. Who knows but some morning it might be found trying to stand on its head! The force of example, however, is wonderful. Now that there is a sedate and stable concrete structure alongside of it, our mercurial friend in cast iron, having sown its wild oats, appears to have settled down into a sedate and sensible tank also, and promises to do good service for many a year. As a matter of fact, the new construction has consolidated the ground in its neighborhood, and so improved its understanding.

In strict justice, my clerk of works deserved a present besides his wages when the job was finished, because his bright and ready commonsense, and his rare aptitude saved the expenditure of scores of pounds. But he got none from the authorities, I am sorry to say. A local body, unlike a human and corporeal entity, cannot give presents; and this, no

doubt, accounts for the omission. To be sure, I handed him a *douceur* in a kind of a shamefaced way that it was so small an acknowledgement of his worth. Never mind, he had his rewerd. The tank, when it was filled to the brim with water, proved to be as tight as a bottle.

Discussion.

The President, in inviting discussion, said the moral of the paper was to be sure of having a good foundation on which to raise any superstructure. Some 35 years ago, when at Portsmouth, he was sent for to Ventnor to advise as to a 6-inch governor which was out of order. When it was erected, it had a brick foundation; but he found this had been removed, and it stood on a four-legged stool. The foreman said this was very convenient, because when it sank a bit on one side they sawed a piece off the leg of the opposite side, and so brought it level. At the same works, Mr. Alexander Wright and himself on one occasion superintended the getting of a station meter through a doorway. They tried every way they could think of one afternoon, and could not get the meter through; but when they went down the next morning, it rolled in easily enough. At the same works a whole stack of retorts sank 3 inches in one day; and it cost about £3,000 to build a sea wall to keep out the water. When a tank was constructed at Ventnor, they thought that they had a good foundation on what was called the "blue slipper." When dry, it was as hard as a rock; but when water found its way to it, it slipped. This was a 61 feet tank; and when he went to see it on one occasion, he discovered it had slipped over just half-way down horizontally, owing to the water having reached the blue slipper and produced pressure behind it. It cost £600 to put the tank right. Again, in Ryde they were making a tank 71 feet in diameter; and when they had got down 15 feet, he found they could go no further. The ground was one-third running sand, one-third a 2-inch stratification of stone, and one-third clay. He had some good Portland cement concrete put down; and he did not think the tank had ever leaked from the moment it was made, for it was always full. This showed the value of good concrete; and if it could be put down right, it would stop these difficulties. Running sand was a great trouble. He once had to build a tall chimney, and was obliged to go down 22 feet 6 inches before he came to solid rock for a foundation; and he had to fill the whole of it up with concrete before the chimney could be constructed.

Mr. Miles remarked that Mr. Newbigging did not say how he got rid of the vast quantity of water which he must have had to contend with, nor what effect it had on the surrounding ground when he had succeeded in doing so. One of the most interesting points in the paper was the reference to the "Mark Tapley" clerk of the works; and he thought his name ought to be given, for his services were certainly worthy of world-wide recognition.

[A Paper read Before the British Gas Institute.]

The Manufacture of Sulphate of Ammonia.

By Mr. Harrison Veevers.

Although in these days the primary object of the destructive distillation of coal is to obtain an illuminating gas, yet it is interesting to learn that the first British patents in connection with gas industry were for what are now considered residual products—the question of the production of gas being conspicuous by its absence. The first patent registered was by John Joachun Becher and Henry Searle, in 1681, for "A new way of makeing pitch, and tarre out of pit coale, never before found out or used by an other." The second was one in which Martin Eele, Thomas Hancock, and William Portlock, in 1694, had a grant of "especiall lycence" for a similar purpose. The *modus operandi* is described as "breaking, grinding, and boyling roch or roofe stone" (so that the plan adopted would scarcely be considered as destructive distillation), until, in 1716, Talbot Edwards proposed to obtain the "pitch, tarr, and oyl by fluxing with fire only." In 1781 there is the first mention of a volatile alkali (which would be ammonia) in a patent taken out by the Earl of Dundonald, the father of the celebrated commander, who describes his invention as a "method of extracting or making tar, pitch, essential oils, volatile alkali, mineral acids, salts, and cinders from pit coal," by a process similar to the present method of making hard coke; but no importance seems to be attached to the volatile alkali. Ten years afterwards, John Barker took out the first patent for the production of "inflammable air;" and it is somewhat surprising to learn that the object of this invention was to obtain motive power, and not light. This is virtually the first gas engine invented; and another patent was taken out in 1794 by Robert Street for a similar purpose. In both cases gas and air were exploded in a cylinder.

Very obscure references are made in these early patents to the uses of the distillates. In one, the inventor states: "The tar, oil, and volatile alkali is distilled from schystus," and its uses were for "destroying and expelling garden, field, and house vermin, and in the preserving of sown seeds and plants from being eaten by vermin." The first specific patent for treating crude ammonia was taken out in 1837 by George D. Midgley and John Howard Kyan, 34 years after the well-known Winsor had patented his method of distilling coal to procure gas to produce light and heat, also "for increasing and multiplying force and power."

It would appear that the early gas engineers considered the tar and liquor as intolerable nuisances. To dispose of them was a serious matter. Turned into water courses, fish and cattle were destroyed; the ammonia was uninflammable, the tar was unsalable. So to get rid of these products, land was rented away from the gas works, deep holes were sunk, and the tar and water buried, to the bewilderment, perhaps, of future geologists. Works near the sea had submarine pipes laid to convey the fluid away from land. There was then the anomaly of two sets of inventors distilling coal, each seeking one description of product and discarding the other. Our earlier engineers were too much concerned with the mechanical problems in the way of producing gas to be able, if indeed they were capable, to study the chemistry of their business. But in time chemistry kindly taught the profession the pecuniary advantages of the bye-products. It taught that by distillation tar yielded a wealth of marvelous colors and scents—indeed, that all its derivatives and its *caput mortuum* were of value in increasing revenue, so as to reduce the price of the prime product, gas; and that it included in its composition combinations of such complexity and number as to afford almost endless variety. An account of the chemistry of tar products alone would now fill more volumes than the chemistry of all organic and inorganic substances half a century ago. Nor has the sister residual—the crude ammoniacal liquor—been neglected by the vigilant attention of chemical science, though not yielding such manifold results. Owing to the complexity of the treatment of tar, and to its more dangerous nature, most gas authorities dispose of it in its crude state; not so, however, the liquor. The very simplicity of the process, and the safety of the manufacture, are inducements to the gas manager to undertake the work of making sulphate, particularly when the gas works are remote from the works specially devoted to the industry, and the conveyance of the liquor is expensive. Broadly speaking, there are three processes for converting the ammonia of gas liquor into sulphate of ammonia. The writer's earliest experience of the first system at gas works was about 40 years ago. The gas works were near the center of a large town; and one is surprised at the forbearance of the residents in allowing the manufacture of the salt to be carried on in their midst. In the gas works was a large brick building with massive walls 5 feet thick. This had been erected to contain a gas holder; the intention being that, in the event of an explosion, the sky rather than the earth should feel the dire effects. With advancing knowledge, however, gas holders were erected in the open; and this building was utilized for the manufacture of sulphate of ammonia. Pans of wrought iron were ranged on two sides of the room; each pan having its own furnace. The liquor, mixed with sulphuric acid, was heated, and water and sulphureted hydrogen evaporated until the combined acid and alkali were sufficiently concentrated and salts of sulphate of ammonia were formed. The crystals were "fished" out with wooden ladles, and a black, dirty looking salt was the result. But who can describe the abominable smells given off during the process? It is charitable to assume that the olfactory perceptions of the people of that period were not so keen as those of the present. Complaints, however, must have been made; and the nuisance was somewhat abated by the pans being covered, and the fumes inhaled by a fan and driven through purifiers charged with oxide. But the salt was not satisfactory in appearance, and the waste of fuel was great.

The second step in the mode of manufacture was to drive off the ammonia and other gases by heat applied to a still. This still was generally a circular one with a dome. A fire having been lighted in the furnace, the gases driven off were conveyed to a thick lead or wooden lead-lined saturator charged with sulphuric acid, which, of course, united with the ammonia, and the sulphur gases were conveyed to the furnace, converted into sulphurous acid gas, and so carried away. By this plan, only the volatile ammonia was driven off; and any ammonia fixed to acids derived from sulphur, chlorine, or carbon was lost, unless released by the intervention of lime, soda, or other alkali. The addition of lime, even, was, however, of questionable value, owing to the cost of it, and of the labor in keeping the material well mixed. The two faults of this system were its cost in fuel and its risk. If the still were not carefully examined periodically, there was a danger of the neck being choked with carbonate of ammonia, and an explosion occurring.

The third and most modern plan of making sulphate of ammonia no doubt derived its origin from apparatus used in distilling alcohol; and Æneas Coffey, of Dublin, who patented his celebrated still in 1832, may be considered the forerunner of all the inventors of the present continuous plan of distilling ammoniacal liquor. To this still, to the scientific use of lime, and to the regenerative use of the heat, may be ascribed the success of the present method. It may be remarked that if the judicious use of lime, magnesia, or alkali is of economical importance, it has to be so applied as not to cause an incrustation in the vessels employed, nor in such quantities as to be wasteful of lime, or on the other hand of fixed ammonia. After the introduction of the Coffey still, and the economical use of lime, the great merit of the present system is the adoption of the regenerative principle so useful in many ways in the gas industry. Its application is simple and ingenious. The first point to be remarked is that the heat is applied in the form of steam of low pressure; the heated vapors leaving the saturator are utilized to warm the incoming crude liquor to such an extent that the bulk of the free ammonia is driven off without any expense in fuel. This plan of making sulphate has been so often described, and is so well known to the profession, that further description is not required. It is difficult to imagine how further improvements can be made in the distillation of ammonia, though in the after treatment of the salt mechanical assistance has been required. In the pan system, the salt was fished out direct; in the still plan, the saturator was of necessity introduced, and at first the contents were run into vats or wooden cisterns—the mother liquor, after the removal of the salt, being ladled or pumped back into the saturator. This is, in fact, the before-mentioned patent of Messrs. Midgley and Kyan, in 1837, who state that, after the free ammonia and that liberated by lime were united to dilute sulphuric acid in a saturator, "the salts produced are to be crystallized by evaporation in suitable open vessels." By this plan, the sulphur gases generated by the distillation would be conveyed to the furnace; but the expense of fuel for the still, and afterwards for the evaporating vessel, would be considerable. Subsequently, however, the saturator was improved by being made with a sloping bottom, so that the salts when formed, being of greater specific gravity than the liquor, passed under an apron to the front, and from there were "fished" or lifted out (by means of copper or wooden ladles pierced with holes), placed on a drainer, and then conveyed to the store.

Up to this point of "fishing," further improvements, except in minor points, seemed impossible; but any visitor to a sulphate manufactory must have noticed the slow, laborious work of fishing out the salt—an occupation detrimental to the health and clothing of the workmen, often injurious to their eyesight, and expensive to the manufacturer. As mechanical labor is cheaper and more manageable than manual, and the nature of this work is mechanical, efforts have been made to tranfer the salt from the saturator to the drainer by machinery; but to do this on the principle of a river dredger would be clumsy and expensive, and machine power is not always available. But the steam ejector has been adapted to this use, and Mr. Wilton, Engineer of the Chemical Department of the Beckton Gas Works, has, after many trials, been so fortunate as to solve the problem presented in the department of the manufacture of sulphate of ammonia. Having been interested for so many years in the business, the writer sought, and at once obtained, permission to see the plan in use at Beckton; and was so pleased with its simplicity and utility, that he determined to bring the subject before his brother engineers. The plan, which Mr. Wilton has very properly covered by a patent, is as follows: The salts, when formed and gravitated to the front of the saturator, are lifted by the action of a steam jet on to the drainer, from which the surplus moisture is conveyed back to the saturator by gravitation. Such, in brief, is the principle; but, in settling the details, considerable thought and many experiments were required.

At Beckton the apparatus was raising the salt from four combined saturators without manual work, and in much less time than would be required by hand labor; so that the economy was self evident. This invention is the crowning improvement in the manufacture; and to visit a sulphate house fitted with this and other mechanical contrivances, is a surprise to one accustomed to the old methods. The sulphuric acid is conveyed by a steam ejector from an underground to an overhead cistern, from which it descends by gravitation to the saturator; the lime is dissolved by steam and sent to its work by a steam ejector; and now, by this invention, the salt is removed by a similar contrivance. The process is automatic, and requires only the attention, not the labor, of the attendant; the only labor required being in removing the salt from the drainer to the stores.

Mr. Wilton having been asked for statistics respecting the results of working the process, writes from Beckton on the 4th of June, 1890, as follows:

The discharger at work here has been going continuously day and night since about November last without any repairs or trouble of any kind. It is fitted to a set of four saturators joined together by pipes, so as to collect the sulphate into one general tank, from whence the salt is taken up by the discharger and delivered a distance of about 20 feet on to a drainer. The amount of sulphate lifted each day is 26 tons, and the total quantity lifted by this apparatus since the start in November last is 5,000 tons. Owing to the saturators being free from ammonia salt at all times, I have been able to increase the work very nearly 20 per cent.—that is to say, from 10 tons per still to 12 tons 2 cwt.; a small portion of which (about 5 cwt.) is due to other causes, making a net increase of nearly 2 tons. The labor has been decreased by two-thirds; and when the dischargers are at work all through the house, I expect to reduce it still more. At present I have only one man each shift, doing the 26 tons, in place of three, and sometimes four men.

There are so many excellent works on ammonia and its compounds, and the subject of the manufacture of sulphate has been brought so often before The Gas Institute and kindred associations, that the writer, not to occupy the time of the members by unnecessary recapitulations, will add a list of books and papers, so that members may be able to refer, without trouble, to the originals.

Works on Ammonia.—An article in "King's Treatise on Coal Gas," edited by Thomas Newbigging, Esq., C.E., Vol. III., p. 256 (1882.) "Coal Tar and Ammonia," by Dr. Lunge (second edition, 1887). "Ammonia and Ammonium Compounds," by Dr. Arnold, translated from the German by Dr. Colmon (Sampson Low and Co., 1889.)

[This book is useful, not only for its information and plates, but at the end is a list of recent literature, British and foreign, and English patents, during the past 20 years. In alluding to these books and patents, I would remark that it would be of great value to managers and to students of gas manufacture if The Gas Institute and the local Associations possessed libraries of works on the technicalities of the gas profession, and copies of patents bearing on the industry.]

The following papers bearing on the subject appear in the transactions of The Gas Institute:

"On Manufacturing Sulphate of Ammonia in Small Gas Works," by Mr. J. Eldridge, 1871, p. 47. [This describes a system now antiquated.] "The Estimation of Ammonia in Gas Liquor," by Professor Foster, 1879, p. 99.] "Modern Apparatus for the Manufacture of Sulphate of Ammonia," by Mr. W. Hindson, 1882, p. 168. "Methods of Manufacturing Sulphate of Ammonia and the Adaptability of the Apparatus to the Production of Caustic Ammonia," by Mr. F. D. Marshall, 1882, p. 174. [The reading of these last-mentioned two papers was followed by a long and interesting discussion, in which Professor Foster, among others, took part.] "Claus's Ammonia Process of Gas Purification," by Mr. C. Hunt, 1886, p. 84. [The discussion on this paper was enriched by the remarks of Professors Heaton and Foster.] "Croll's Process of Sulphate Making," by Mr. George Anderson, 1887, p. 77.

The following papers, with discussions, are recorded in the Proceedings of Associations of Gas Engineers and Managers:

"Notes on Ammoniacal Liquor," by M. J. H. Cox, Jr., read before the North of England Association at Leeds, 1883, p. 226. [This enters exhaustively into the chemistry of ammonia and its compounds.] "Results obtained in the Manufacture of Sulphate of Ammonia and Sulphuric Acid," by Mr. J. Hepworth, 1883, p. 235. [This paper was read at the same meeting as the preceding one, and both are quoted in the work of Dr. Lunge on "Coal Tar and Ammonia," pp. 567, 596.] "On the Manufacture of Sulphuric Acid in Connection with Gas Works," by Mr. J. Hepworth, 1885, p. 70 [Read before the same Association at Newcastle-on-Tyne.] "On Something about Sulphate of Ammonia," by Mr. C. D. M'Allum, 1885, p. 73. [At the same meeting as the above.] "On the Present Depression and Future Prospects of Sulphate of Ammonia," by Mr. Bradbury, 1885, p. 197. [Read before the Manchester District Institution of Gas Engineers at Liverpool.]

Discussion.

Mr. W. Hardie, Jr., (North Shields) said the paper would be very valuable as a complete historical record; but, so far as he had gathered, the only novelty mentioned was the carrying of the salt from the saturator on to the drainer by some system of steam ejection. He did not quite understand how it was done; and he should like to know if the salt was in the solid or the liquid form.

Mr. Miles asked if Mr. Veevers had seen the apparatus in operation, and if so, whether or not there was any difficulty in its manipulation. He said he had not heard any mentioned; but it occurred to him that if

the solid salts were carried by the ejector, there would be a tendency to choke the apparatus. He should also like to know if the system could be applied to an ordinary saturator, and what was the monetary saving by the Wilton apparatus.

Mr. J. T. Sheard (Salford) inquired if the constitution of the salt was in any way affected by this process. There seemed to be no doubt, as to its practicability, because the results at Beckton had been given; but it occurred to him that possibly the salt might contain more acid, and also more water of hydration. Ordinary sulphate of ammonia seriously affected the bags in which it was placed, and very soon rotted them; and he thought this might be even werse. Had any analysis been made of it?

Mr. J. Booth (Southport) said he had been a manufacturer of sulphate of ammonia for eight or nine years. He commenced on the intermittent system; and then, as the make of liquor increased, adopted the continuous process. At the end of last year he found he should have to enlarge his sulphate plant, and make continuously. He determined to adopt the best possible system; and the plan described in the paper was brought to his notice by Mr. Veveers. He at once saw that it would save a great deal of labor; and a month ago, in company with two of his committee, he had visited the Beckton works, and witnessed the process in operation. He was surprised at the ease with which the solid salt was elevated from the saturator, and conveyed on to the draining table; and he failed to see any danger such as Mr. Sheard had alluded to. As far as he could learn, the sulphate was all that could be desired. His committee had decided to adopt the process; and he hoped soon to have it in use.

Mr. C. H. Hutchinson (Barnaley) asked if the process made any difference, in the amount of ammonia in the finished salt. Was that made at Beckton still guaranteed to be 25 per cent., and had it to remain in store any longer than usual before it was fit for market?

Mr. Miles inquired to what cause the increase of about 20 per cent. in the result was attributable.

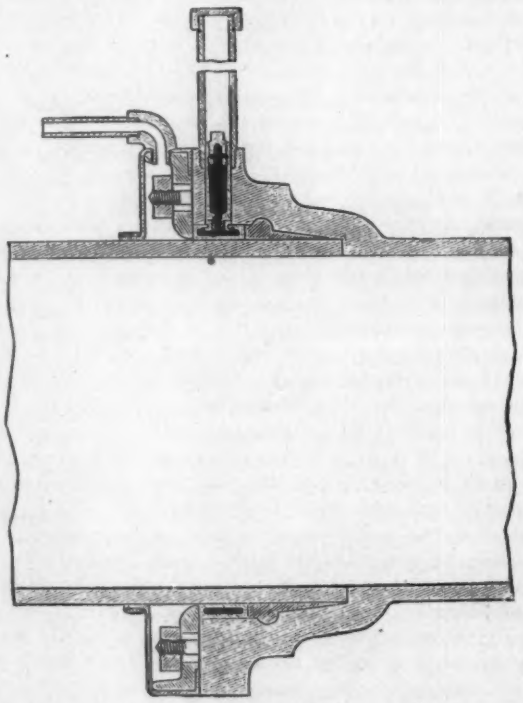
Mr. Veevers, in reply, said the salt as raised by the ejector was semi-liquid, but rather more solid than liquid. The water drained quickly away to the saturator; leaving the salt fit for removal to the store. Having seen the apparatus at work on a very large scale, he thought it well, before writing his paper, to try it on a small one; and he had worked it very satisfactorily for a week. He found that, instead of employing two men, he could do the work easily with one. Mr. Wilton said he saved three men out of four. He had not found any choking in the ejector. At Beckton there were four saturators leading into one tank, from which the salt was lifted out; and the work went on continuously night and day. In his own small works, having but one saturator, it was only put in operation when the salt was formed. As soon as the salt began to appear, they commenced to lift it out; and the water drained back again into the saturator. He had sent two samples to analytical chemists, and was surprised to find that there was slightly more ammonia in this salt than in that raised by hand. The authority for the statement that there was a saving of 20 per cent. was Mr. Wilton's letter. It arose through economy of labor.

The President said there was one important point in the paper which the Council had already taken into consideration—viz., the formation of a library of reference at the new offices in Victoria street. He had already been looking through his own library, and should be happy to place in the hands of the Secretary his first contribution toward the library. He merely mentioned this in the hope that other gentlemen would be induced to do the same.

The Berryhill Pipe Joint.

Numerous advantages are claimed for a pipe joint that has been put on the market by Mr. A. Berryhill, of Pittsburgh, Pa., among which may be mentioned its adaptability to changes in alignment of the pipe, its tightness, it is asserted, not being affected by unequal settling of the different lengths of pipe; also the ease with which an arrangement may be put on the pipe for collecting such leakage as may take place and determining its location, and also the means provided for stopping such leaks as may be found at the joints without uncovering the pipe or interfering with travel in streets in which the pipe is laid.

As shown in the illustration, the bowl of the pipe is made slightly funnel-shaped, to admit of deflection, the packing about the end of the pipe being lead, pitch or other suitable packing. Back of this is a ring of rubber packing of rectangular section and hollow. This is opened at one point, the top of the pipe as shown in the annexed cut, and connection made with a reservoir containing fluid, preferably glycerine. Connected to the main pipe at this point is a smaller vertical pipe extending nearly to the surface of the ground. The rubber packing ring is held in place by an iron ring bolted to the bowl of the pipe and fitting quite closely around the spigot of the other length of pipe, provision being made for deflection by making the bolt holes somewhat larger than the bolts. It will be seen that the passage between the vertical pipe and the hollow rubber packing is closed by a screw having a hole bored lengthwise nearly through it, and another hole meeting the first and at right



angles and passing completely through the screw; by means of these holes free passage is established between the packing ring and the vertical pipe. In laying pipe with this joint, or tightening the joints of that already laid, the method of procedure is as follows: The screw bored as above described is slackened until the transverse holes are in communication with the vertical pipe, when a suitable forcing pump is attached to the upper end of the vertical pipe and the glycerine contained therein forced down into the hollow rubber packing, expanding it and making the joint gas-tight. This done, the screw valve is again tightened until it occupies the position shown in cut, the wrench for tightening same passing through a stuffing-box in the pump, that the tightening may be done under pressure.

The inventor claims that this method of packing will insure a tight joint even under considerable deflection of the pipe, for a bending in one direction will compress the hollow rubber packing ring, squeezing the glycerine out from that particular point and filling the ring on the opposite side of the pipe, where the ring will be allowed to expand.

The device also includes means of collecting such gas as may escape, and ascertaining at what joint the leakage exists. A strip of canvas made gas-tight by pitch or other suitable substance is inserted and securely fastened between the outer end of the bowl of the pipe and the iron ring behind the rubber packing, and drawn down to the pipe a short distance from the joint and fastened to the pipe by wiring or other means. Into the space thus enclosed all gas which may escape will be collected, and from it, as shown at the top of the cut, a small pipe leads along the main to some convenient point, where these small pipes are brought to the surface, and each bearing a distinguishing number, the location of any leaking joint be at once ascertained, and, being found, be remedied by the means above described.

MAYOR LONDONER, of Denver, has signed the bill catalogued as "Supervisor's bill, No. 52," which concerns the public lighting of the city. The bill authorizes the Western Electrical Construction Company to furnish the city with 250 electric arcs (2,000 candle) and a certain number of tower lights, each arc to be paid for at the rate of $120 per annum. The contract is to run for 5 years, from January 1, 1891. The most important inference to be drawn from this is that Denver will have no more of the incandescent type of electric street lighting, which system has been in vogue there for some years.

The Greenough-Jones-Addicks Improved Apparatus for the Manufacture of Gas.

Messrs. M. S. Greenough, E. C. Jones and W. R. Addicks, of Boston, Mass., were, on June 3d, granted protection (U. S. Letters Patent, No. 429,309) for certain improvements in apparatus for gas making. In their description of the apparatus the inventors say:

Fig. 1 represents a plan view of our improved apparatus for making illuminating gas, a portion of the generator being shown in section. Fig. 2 represents a longitudinal section on the line *X X* shown in Fig. 1, and Fig. 3 represents a cross-section on the line *Y Y*, shown in Fig. 1.

Similar letters refer to similar parts wherever they occur on the different parts of the drawings.

In carrying out our invention we make use of a gas generator *A* (shown in Figs. 1 and 2), having, as usual, a central firepot *a*, in which the fuel *B* is contained; *a'* is an opening through the upper end of the generator for feeding the fuel into the firepot and for admitting air thereto, so as to bring the fuel to incandescence after being ignited, as is common in certain designs of water gas apparatus.

The opening *a'* is adapted to be closed by means of a cover *a''* previous to the introduction of steam and liquid hydrocarbons into the heated contents of the firepot in the ordinary manner.

a² is the grate at the lower end of the firepot *a*, as usual, below which is the central passage *a⁴*, communicating with the horizontal flue *a⁵*, leading to the boiler *C*, which is represented as a vertical tubular one with tubes *c c c*; but this is not essential, as any well known form of boiler may be used without departing from the essence of our invention. While the fuel in the firepot *a* is being brought to incandescence the heated products are made to pass downward through the passage *a⁴*, through flue *a⁵*, and up through the boiler tubes *c c c* and into a heating chamber *D*, preferably arranged on top of the boiler *C*, as shown in Fig. 2; but this is not essential, as said heating chamber may be constructed and arranged relatively to said boiler without materially affecting the nature and purpose of the invention.

d is a pipe leading from the heating chamber *D* to any place where it is desired to store or use what is termed "producer gas" or "fuel gas," obtained by the combustion of the fuel in the generator during the time the latter is brought to a high heat and previous to the introduction into the incandescent fuel of steam and liquid hydrocarbons. The object of the heating chamber *D* is to utilize the radiated heat from the producer gas to vaporize the liquid hydrocarbon before the latter is fed into the firepot, and for this purpose a series of pipes *E E* are arranged inside of the chamber *D*, and preferably connected together outside of said chamber by means of elbows or return bends *e e*, so as to ascertain any leakage that may occur where the pipes and bends are connected, as well as to prevent such leakage from taking place inside said heating chamber.

Fig. 1.

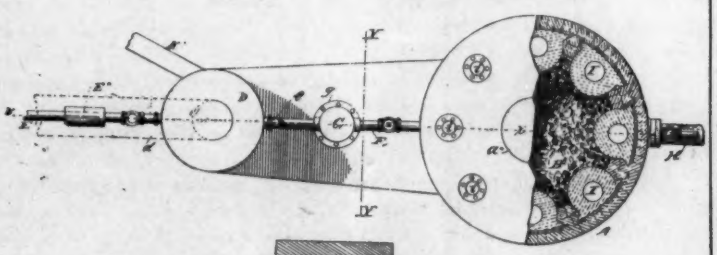


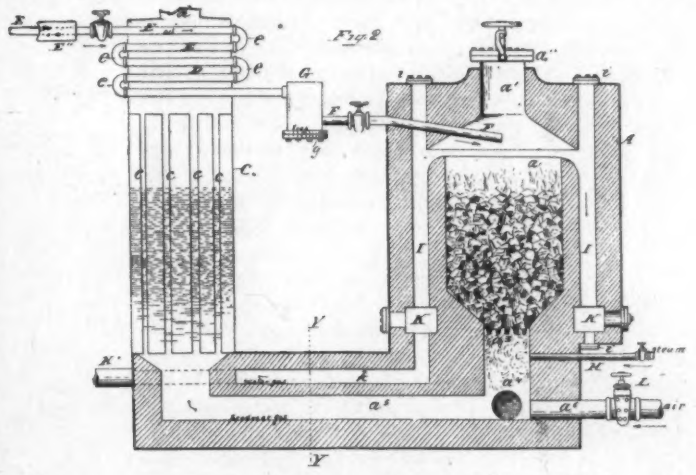
Fig. 3.

E' is the hydrocarbon supply pipe, connected in a suitable manner to one end of the system of pipes *E E*, which pipe is preferably surrounded by a jacket or chamber *E''*, containing steam, so as to raise the temperature of the liquid hydrocarbon more or less, as may be desired, before it is passed through the vaporizers *E E* on its way to the generator. One end of the pipe system or vaporizers *E E* is connected to the upper portion of the firepot *a*, or internal part of the generator, by means of a pipe *F*, as shown in Figs. 1 and 2, and we prefer to locate on such pipe, between the vaporizer and generator, a closed chamber trap or box *G*, adapted to arrest and collect tar or heavier matters not carried over in suspension to the generator, such trap or box being preferably provided with a removable cover *g*, which may be detached whenever it is desired to remove the accumulation from said box.

H is a steam pipe leading from any suitable source of steam pressure to the interior of the firepot *a*, as shown in Fig. 2.

Around the firepot *a* we make a series of vertical flues or passages *II*, communicating with the upper part of the firepot or combustion chamber *a*, as shown, said flues being preferably extended from top to bottom of the generator to enable their being cleaned when clogged, and closed in their upper and lower ends by means of suitable covers *i i*. The lower ends of the flues *I* communicate with an annular chamber *K*, surrounding the firepot or combustion chamber at or near its lower end, as shown in Fig. 2. From said annular chamber *K* leads a pipe, flue, or channel

Fig. 2



k, provided with a delivery pipe *k'*, to the scrubber, purifier and holder of the gas works.

In Figs. 2 and 3 we have shown the flue *k* arranged parallel and in close proximity to the producer gas flue *a⁵*, for the purpose of utilizing the heat of the latter in additionally fixing the gas passing from the generator through said passages *k*; but we do not wish to confine ourselves to this precise arrangement, as, if so desired, a pipe may be led direct from the annular chamber *K*, without going through the brickwork, of which the flue *a⁵* forms a part.

The chamber *a⁴* or flue *a⁵* may be provided with an air inlet *a⁶*, provided with a suitable valve, gate, or cut-off *L*, for the purpose of admitting air to the flue *a⁵* during process of combustion of the fuel *B*, and thus increasing the heat of the gaseous products carried to and through the boiler *C* and heating chamber *D*, as well as heating the flue *k*.

The operation of our improved apparatus is as follows: The firepot *a* is filled with fuel *B* through the upper opening *a'*, and the fuel ignited and brought to incandescence by forcing air in at the top of the generator and through the firepot by means of a steam jet or any of the well-known mechanical exhausters, preferably placed at some point on the fuel gas delivery pipe in the ordinary manner, the gaseous products passing through chamber *a⁴*, flue *a⁵*, boiler *C*, and heating chamber *D*, and out through pipe *d* to the place where the producer or fuel gas is to be stored or used, and during such operation the walls and brickwork of the generator are brought to a very high degree of heat. The water in the boiler *C* is heated, and steam produced therein to be used for any purpose desired, and the liquid hydrocarbon in the pipe system *E* is vaporized previous to being admitted to the interior of the generator. When the fuel in the firepot *a* has been brought to incandescence, the pipe *d* and opening *a'* are closed by any suitable devices and steam forced from pipe *H* upward through the incandescent fuel *B*, causing water gas to be produced by the decomposition of the steam, the hydrogen gas of which is set free and its oxygen combined with the carbon of the fuel, producing carbonic oxide gas, as is common in devices of this kind. At the same time that the steam is forced through the incandescent fuel the highly vaporized hydrocarbon is admitted through pipe *F* into the upper part of the combustion chamber *a* above the fuel therein, causing the water gas to be carbureted, by which it is converted into illuminating gas, which is forced downward through the heated flue *I* into the heated annular chamber *K*, and by passing through said heated passages the gas is made fixed, after which it may be still further fixed, if so desired, by passing through the heated flue *k* on its way to the scrubber, purifier and holder, as hereinabove described.

In practice we prefer to arrange the apparatus in twin form with two generators in the system, so that while the fuel in one is brought to incandescence, illuminating gas is produced in the other, and vice versa, by which a continuous production of the illuminating gas is maintained.

Hambleton's Apparatus for Measuring and Carbureting Air or Gas.

On June 3d U. S. Letters Patent (No. 429,271) were granted to Mr. Francis H. Hambleton for certain new and useful improvements in apparatus for measuring and carbureting air or gas. The inventor's specification is substantially as follows:

The method of measuring and carbureting gas at the place of manufacture as now generally in use is by trial an error—that is to say, by practically testing from time to time the proportions of gas and hydrocarbon and setting the faucet accordingly. By this method there is neither accuracy nor regularity. By my method these tests are avoided, and I provide an automatic and co-operative method of indicating and recording the exact proportions of gas and hydrocarbon, which may be ascertained by an unskilled operator simply by inspection, and means for varying these proportions, which may be readily applied to produce the exact proportions required.

The following description, illustrated by the accompanying drawings, shows an apparatus as applied to the ordinary street gas.

Fig. 1 is a view of the gas meter, with the cylinder shown in section, giving a view of the interior revolving drum actuated by the gas. The shaft upon which the drum is mounted is connected by gearing to the upright shaft which operates the buckets or dippers in the hydrocarbon meter. It also shows the meter and the pipe (broken away) which leads to the mixing chamber. Fig. 2 is an end view (broken away) of the hydrocarbon meter, showing bracket which supports the gearing and the pipe leading to mixing chamber. Fig. 3 is an end view of the gas meter furnished with a dial, also showing the outside gearing which revolves the dippers in the hydrocarbon meter, and the end of the pipe leading from the gas meter to the mixing chamber. This figure also shows a series of dials for marking the quantity of hydrocarbon. Fig. 4 is an end section of the hydrocarbon meter, showing the revolving buckets or dippers. Fig. 5 is a side view of the meter dial provided with a front door, and a view of the shaft which receives motion from the meter and imparts it to the upright shaft which works the revolving buckets in the hydrocarbon receiver. Fig. 6 shows several wheels of varying number of teeth, intended to be substituted for the wheel a^8 to vary the proportions of hydrocarbon to enrich the gas as required.

Viewing Fig. 1, A is the outer casing of the gas meter cylinder, broken away and shown in section; a', a bracket within the cylinder to support the shaft a^2. Upon this shaft is mounted the drum a^3. The drum a^3 is revolved by the passage of gas through the cylinder, and marks the number of cubic feet of gas passing through the meter upon the dial. (Shown in Fig. 3.) Located at one side of the shaft a^2, and supported by the head of the cylinder, is journaled the shaft a^4, far enough removed from the center of the cylinder to escape the door a^5 when opening or closing. Upon one end of the shaft a^4 is secured the wheel a^6 (see Fig. 5), which meshes with the wheel a^7, secured to the shaft a^1. This latter wheel imparts revolution to the shaft a^4, which has secured to its opposite end the wheel a^8. Upon a bracket a^9, secured to the head of the cylinder, is journaled the shaft a^{10}, which carries the bevel wheel a^{11}. The shaft extends through the bracket, and upon its other end are secured the wheel a^{12} and lever a^{13}. Upon this lever is also pivoted the wheel a^{14}, which meshes with the wheel a^{13}, and as the lever is pivoted centrally with that wheel and with the shaft a^{10} it may be moved up or down without affecting the wheel a^{13} or its position with the wheel a^{14}. This latter wheel meshes with the wheel a^6 when the lever is down, thus imparting revolution to the shaft a^{10}. The object of this arrangement is to change the wheel a^8 and substitute therefor one of a different number of teeth, so that a relatively faster or slower motion may be given to the shaft a^{10} at the will of the operator. An offset in the bracket a^9 serves to support the end of the upright shaft b, to which is secured the bevel wheel b', which meshes with the wheel a^{11}.

B is the hydrocarbon meter, through which runs the shaft b^2, journaled in the heads of the case of the meter. Passing out of one end, it is journaled in the bracket b^3, and carries on its end the bevel wheel b^4, meshing with the wheel b^5 on the end of the shaft b. Upon the shaft b^2 is secured the bucket wheel provided with the buckets or dippers b^6. These buckets are provided with stems which are inserted into the hollow hub b^7. This hub has a discharge outlet (shown at b^8).

The meter B is divided into compartments by the partition walls b^9 and b^{10}, the partition b^9 being higher than b^{10}, so as to retain the hydrocarbon and allow it to overflow the partition b^{10}.

b^{11} is the inlet pipe, which conducts the hydrocarbon from a receptacle (not shown in the drawings) and discharges it into the carburetor. The supply is regulated to be greater than the demand, so that the liquid will be kept always on a level with the partition b^{10}, and the surplus allowed to overflow and be drained off through the pipe b^{12}. As the buckets b^6 revolve they dip up the required quantity of the liquid, which runs into the adjoining compartment through the discharge b^8, and thence out of the pipe b^{12} to the mixing chamber or carburetor (not shown in the drawings), where it meets the gas discharged into the same chamber through the pipe A', and from thence to the benches (not shown in the drawings), where it is fixed at the required rate.

FIG. 2

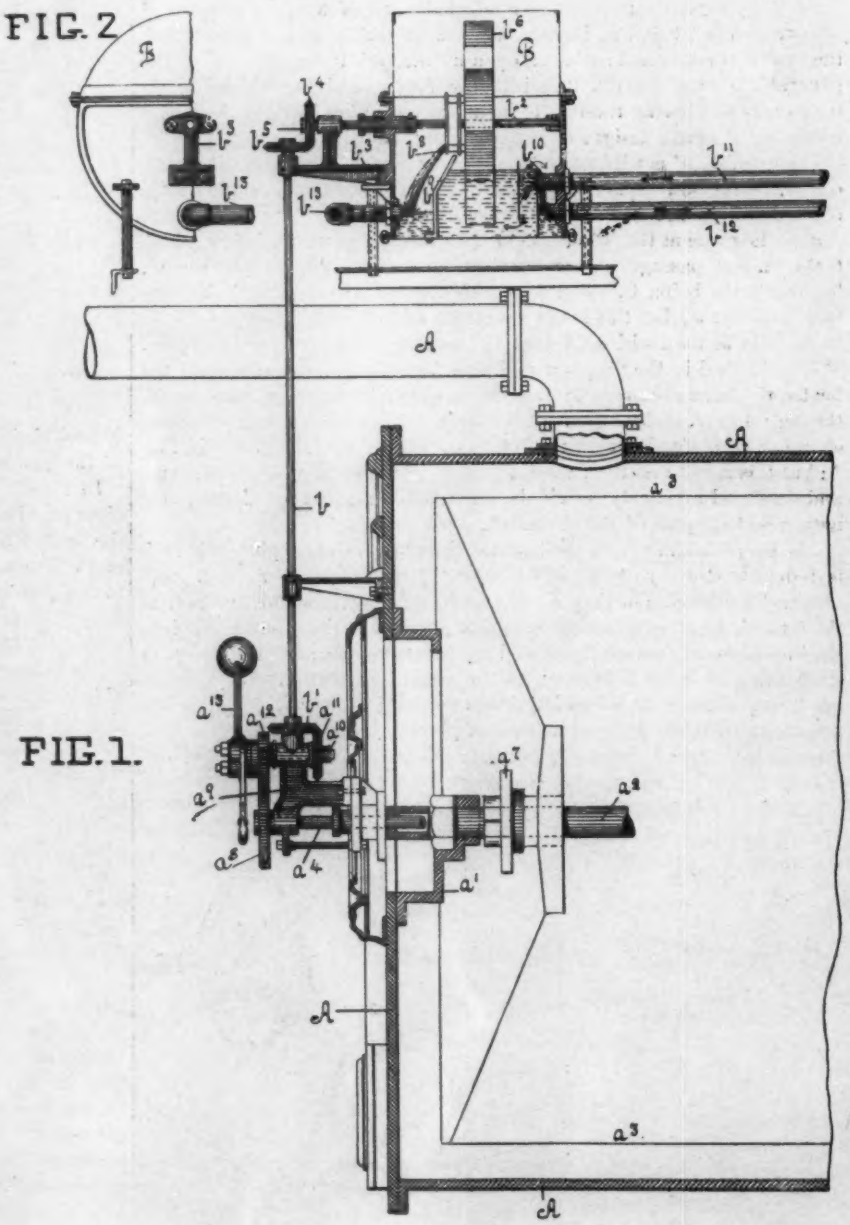


FIG. 1.

The operation of the device is as follows: The air or gas passing through the meter revolves the drum a^3, which indicates upon the dial the number of cubic feet of air or gas passing through the meter. The wheel a^2 in its turn revolves the bucket wheel in the hydrocarbon meter through the mechanism already described. As the revolution of the drum a^3 is increased by a greater quantity of gas passing through the meter and measured thereby, there is a corresponding increase in

the revolutions of the hydrocarbon meter and an increase in the supply of hydrocarbon, thereby maintaining the supply of hydrocarbon in proportion to the gas which is measured and indicated by the dials $x\,x$. Should other means be used to aid the air or gas in turning the drum a^3 faster than by the ordinary flow of the air or gas, an increased quantity of gas would pass through the meter, and consequently an increased supply of hydrocarbon would be measured out and indicated by the dials. In either case the gas passing through the meter would ascertain the supply of hydrocarbon. In the manufacture of carbureted water gas, for example, it is sometimes desirable to make it more or less rich in carbon. It is, therefore, necessary to have connected with the apparatus some means by which it can be readily adapted for changing the

FIG. 5.

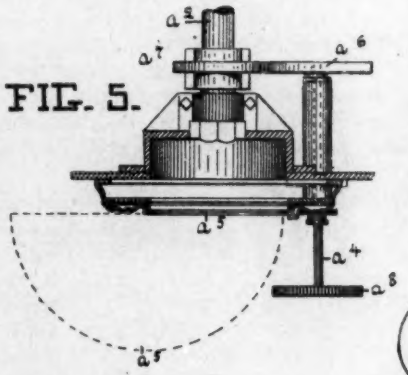


FIG. 4.

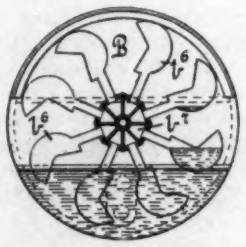
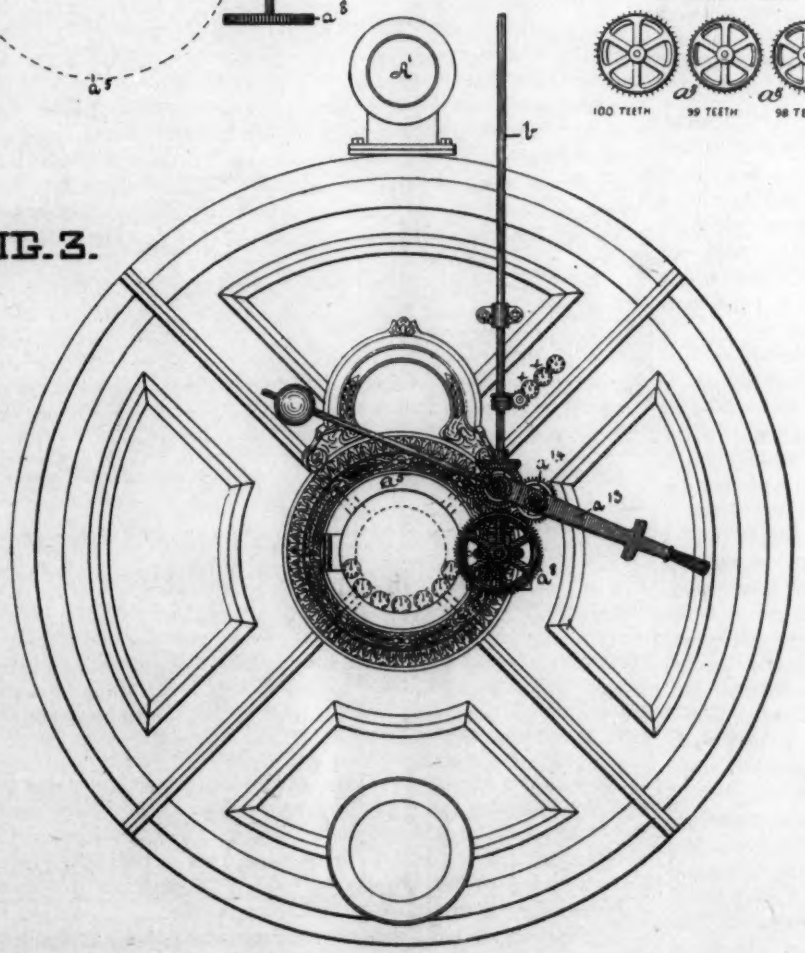


FIG. 6.

FIG. 3.



proportion of hydrocarbon to the quantity of gas. This is effected by the following mechanism:

Viewing Fig. 3, the wheel a^5 is of a size to regulate the supply of hydrocarbon according to a given rate, and, as shown in the drawings, is about the largest size used. It meshes with the wheel a^{14}, pivoted to the lever, which in its turn meshes with the wheel a^{13}, which latter wheel is secured to the same shaft as the bevel wheel a^{11}. It will be seen that as the wheel a^{14} has its center a fixed distance from the wheel a^{13} the lever may be raised or lowered any distance without affecting these wheels. This enables me to change the wheel a^5 and substitute another of different size. As the diameter of this wheel is diminished the supply of hydrocarbon would also be diminished, and vice versa.

In the manufacture of carbureted water gas for illuminating purposes it is impossible by the present methods of mixing the gas and hydrocarbon to arrive at any desired proportions of the two without trial and error, and when any desired proportion is reached only an approximate average running above and below the standard can be maintained, and this only by constant vigilance on the part of the operator. My invention provides an automatic method of producing and maintaining any desired standard of candle power by even unskilled operators, simply by inspection. To effect this control of the mixture, I employ an ordinary station meter for measuring the gas and a specially designed meter for measuring the hydrocarbon, in combination with a gearing device for making the two meters co-operate, so as to produce any desired mixture positively. For instance, if it is desired to mix 6 gallons of hydrocarbon to each 1,000 feet of water gas, one of the series of wheels used on spindle 8 will be found marked for that proportion, and when placed in the spindle it will produce it exactly and maintain it for an indefinite time without alteration. At the same time the recording dials of both meters will record the amount of material having passed through them respectively, so that by the operation of my invention the exact quantity of material used is controlled and registered automatically. Any proportion of gas and hydrocarbon can be produced exactly without trial. Any increase or diminution of candle power can be produced instantly and accurately. In the manufacture of fuel gas the slight amount of carbureting necessary to produce the requisite odors can be produced and maintained exactly.

Electrical Engine Governors.

The principles upon which an efficient governor for motive power engines should be constructed are now so well known that there is no lack of governors fulfilling all that can reasonably be expected from them. There is only one drawback inherent in their construction—they can only act after a certain variation in the speed of the motor has already occurred. The variation required to cause their actions is, in the best governors, very small, and they overtake it with sufficient quickness where the variation in the pressure or load causing the alteration of the speed is comparatively small and gradual. This is the case where a large engine, for instance, drives a considerable number of light machines, each absorbing little power. The stoppage of any one of these, or of a number of them in succession, reduces the load so imperceptibly and gradually that the increase of speed, thereby further controlled in such cases through the heavy flywheel, is so gradual and small that a good isochronised governor can easily keep the engine at its normal speed. The case is different where the engine drives a few machines, some of which take a very large share of the driving power, or where a line of shafting has at times to be suddenly stopped by disengaging a friction clutch. In such cases the difference in the load is so considerable, and the change in the position of the governor necessary for maintaining the speed approximately so large, that as a rule the engine will begin to quicken considerably, and be only reduced to the standard speed, or near to it, after having made some turns. This excess (or retardation, in case of putting the machine or shaft on again) may injuriously affect the work done by the other machinery, and means for preventing it would in such cases be welcome. Mr. A. Levien has submitted an idea for effecting this to the French Academie des Sciences, which we think will be of interest to some of our readers. He proposes to apply an auxiliary small dynamo driving a nut on one of the rods connecting the governor and throttle valve, or cut-off gear, so that this connection is lengthened or shortened by the rotation of the dynamo, and the admission of steam varied thereby in the well known manner. The friction clutch, or parts of the heavy machine referred to, would be connected to contact apparatus, so that the disengagement starts a current which rotates the dynamo at once, and acts in the direction of a reduction of speed before the engine itself has

begun to increase its speed. From the latter a sensitive governor or tachymeter—such, for instance, as is used in Moscrop's indicator—is driven, which is connected with a switch apparatus, so as to allow the current to pass, and drive the dynamo as long as the speed of the engine is at or above its standard rate, but break it as soon as the speed falls below this. To act in the opposite direction on starting the machine or shaft again, arrangements are made for sending a reversed current through the dynamo, to turn the nut in the opposite way, and act in the direction of accelerating the engine before any retardation of its speed has begun. A tachymeter would be driven from the line or machine shaft connected to a switch arrangement so as to allow the current to pass till the shaft has obtained its proper speed, and then interrupt it. This auxiliary apparatus will, of course, leave the governor free to act in other cases where the speed varies through change of pressure, etc. We think the idea is worth considering in cases like those we have pointed out, where sudden and large variations in the load of the engine are of frequent occurrence.

Test of Boilers at the Pawtucket Pumping Station.

By Prof. DENTON.

Engineering Record says that Prof. Denton in determining the influence of the steam jacket on the Pawtucket (R. I.) pumping station (local water works), found it necessary to determine separately the efficiency of the boilers and incidentally the economic value of different kinds of coal. Some of his conclusions on these points as given in a letter to Edwin Darling, Superintendent of the Pawtucket Water Works, are contained in the following extracts:

I was enabled to make the experiments on the No. 1 Pawtucket Pumping Engine, under the following conditions: The engine having been overhauled as usual in March to prepare for the summer run, it should be taken in the condition it might be found, without any extra preparation except the insertion of wells in steam and water pipes for thermometers and valves for meter appliances; also that the usual coal which had been purchased for the season should be used in making the tests, the idea being to have the engine tested under the conditions common to its regular daily work.

The experiments had for their special object the measurement of the steam consumed by the engine per horse-power under various conditions calculated to afford scientific data regarding the application of thermo-dynamic principles in engines of this type. This required the separation of the performance of the boiler from that of the engine. The engine had been several times previously tested without making this separation, the performance being stated in foot pounds of "duty," which expresses the combined economy of the engine and boiler. I had formed the opinion, during several years of acquaintance with the engine, that the high "duty" performed was gotten with a rather inferior efficiency on the part of the boilers, thereby making the probable efficiency of the engine abnormally high even for its type and conditions of special excellence. Having communicated this idea to friends interested in the applications of steam engines through their manufacture and otherwise, I succeeded in securing the subscription of sufficient funds to defray the expense of the test, outside of the pipe-fitting and like labor, which you kindly volunteered to take upon yourself when assenting to my request to be allowed to make the experiments.

The results of the measurements do not confirm my ideas regarding the unequal division of the economy between boiler and engine. The boiler is not of low efficiency, and the engine, while the most economical for its size, if not of any size, of which accounts have been published, does not reach the extraordinary figure I had been led to expect. The boiler evaporates 8.88 pounds of water from 104° Fahr. into steam of 127 pounds pressure with anthracite coal yielding 14 per cent. of ashes at 5 pounds rate of combustion, and 9.35 pounds of water from 104° with Georges Creek bituminous coal yielding 10 per cent. of ashes at 5 pounds rate of combustion. The engine performs a horse-power of work in its steam cylinders with a consumption of 13.75* pounds of steam per hour. Taking into account the percentage of ashes, the performance of the boiler is practically the maximum economy to be expected or gotten from boilers, while the steam consumption of the engine is also unexcelled, as even the most improved marine engines of the triple expansion type using steam at 150 pounds pressure have yet to produce a record of steam consumption lower than 15 pounds of steam per hour per horse power.†

The combined efficiency of the boilers and engine gives a horse power in the steam cylinders with 1.54 pounds of anthracite coal consumed per hour, and 1.48 pounds bituminous coal consumed per hour. Out of a horse power produced in the steam cylinders 95 per cent. is available to force water, only about 5 per cent. being required to overcome the friction of the mechanism and operate the air pump, etc. In this respect also the engine is an extraordinary piece of apparatus. It results from all of the foregoing that the duty per 100 pounds of coal was for anthracite coal 124,750,000 foot pounds, and the duty per 100 pounds of coal was for bituminous coal 127,350,000 foot pounds. These figures are for the actual evaporation of the boilers as given above.

For the fictitious basis on the part of the builder of 10 pounds evaporation per pound of coal, the above figures for duty become 140 and 145 millions respectively. These figures for "duty" practically agree with those reported for the annual work of the engine in 1887 and 1888, when I understand the engine to have run without banking of fires for long periods of time, so that the effect of banking and starting fires in increasing the coal consumption was eliminated, as was the case in my experiments. Should the engine be worked days only, so that banking and starting of fires is required every 10 or 12 hours, then the reduction of duty should, by my observation of the working of your station, be about as follows:

To obtain s duty of 124 millions it is necessary that the coal consumption should average 200 pounds per hour, with 100 pounds every six hours for cleaning fires. Suppose the engine is run 12 hours daily, then at about half after the eleventh hour 200 pounds of coal is fired, and at the twelfth hour the 100 pounds of coal which would be used for cleaning, if the engine was not stopped, is used for banking. During the 11 hours that the fires are banked steam falls to about 80 pounds. To raise steam to running pressure requires 300 pounds of coal, and about 25 minutes after the engine is started 200 pounds more coal are used. At the end of the first hour and 25 minutes of running 200 pounds are again fired and thereafter the same amount is fired per hour.

To run the engine 12 hours, therefore, the consumption is as follows:

11 hours of steady firing, 2,200 + 200 for cleaning,	2,400 pounds.
Raising steam and first 25 minutes.....	500 "
Total.....	2,900

If the engine was running continuously there would have been required for the same 12 hours of work by the engine 12 times 200 plus 200 for cleaning, 2,600 pounds.

The banking therefore requires $\frac{29}{26} = 1.11$ times as much coal as continuous running.

Hence 124 millions duty for continuous running is consistent with $\frac{124}{1.11} = 110{,}000{,}000$ foot pounds "duty" for day service requiring banking.

The reverse of this is therefore also true, namely, that if, as appears from the reports of the engine, about 110 millions duty was performed during daily running and using banked fires, it is reasonable that about 124 millions should be performed during the continuous running in 1887–88.

* * * * * * * * *

Three boilers were used. The grate surface in each boiler was a circle 4½ feet in diameter and 15 square feet in area. Each boiler was a cylinder 14 feet long and 4 feet in diameter, suspended vertically in brickwork and having 48 3-inch tubes running from end to end. The total heating surface in the three boilers was 1,231 square feet in contact with water and 508 square feet of superheating surface.

The boiler flues had been swept clean about 5 days previous to the test. As soon as the fires were evenly ignited the fireman was limited to 200 lbs. of coal per hour, with an extra allowance of 100 lbs. for cleaning every six hours.

So nicely was the firing under control that the furnace doors were scarcely ever opened to look at the fires between the hours. As the hour approached, the allotted 200 lbs. were loaded upon a barrow and brought close to the furnace of one boiler. The damper of this boiler was then closed, the fire door opened and one-third of the barrow load quickly but accurately distributed evenly over the grate, and the same operation was repeated with the other two boilers. Each fire door was open less than one minute.

When the fire was cleaned the engineer assisted the fireman, one using the slice-bar and the other withdrawing the clinkers. The cleaning, including the addition of one-third of the allotted 100 lbs. of extra coal, was accomplished in about three minutes for each fire. On several occasions the whole of the 100 lbs. of cleaning coal was not required.

* Duplicate tests give 13.64 pounds and 13.88 pounds, respectively.

† Tests of S. S. Meteor. Trans. Brit. Assoc. Mech. Engrs.

The above refers to the 72-hour' test, during which the fuel was mainly stove anthracite. It is the practice of the station to screen this coal on a 1-inch square mesh, thereby freeing it of all small pieces of the size equivalent to nut coal. The small size, or that which falls through the screen, is used for banking the fires, while the larger or stove size is used for the bulk of the work. The small screenings were used for starting fires.

The refuse of the anthracite coal collected in the ash pits was 752 lbs. This was screened through a ½-inch mesh and 110 lbs. of unburnt coal obtained. This coal was put on the fires during the last or 72d hour of the test, after the firing with fresh coal had ceased. The clinkers removed during the cleaning of fires amounted to 653 lbs. The contents of the grates at the end of test amounted to 944 lbs.

The anthracite coal was therefore as follows:

Wood, taken as equivalent to 40 per cent. of coal	105	
Total coal fired	15,710 lbs.	
Total fuel used		15,810 lbs.
Consumption per hour	219.5	
Incombustible from ash pits	641	
Incombustible clinkers	653	
Left in furnaces	944	
Total		2,238
Total combustible		13,577

Total refuse equals 14.3 per cent. of fuel.

The bituminous coal made no clinkers, and the fires were not cleaned during the entire 24 hours of its use. No separation of the ashes was made, the total refuse from ash pits and grates combined being 510 lbs.

The total consumption was:

Coal	5,200 lbs.
Wood	80 "
Total in the 24 hours	5,280

Consumption per hour, 218.6. Ashes equal 9.6 per cent of fuel.

I regard the above details of firing, etc., as worthy of note, from the fact that it is a matter of well founded opinion that a very sensible part of the performance of fuel depends upon the degree of skill displayed in firing when the best results are obtained. Beyond doubt the extraordinary annual performance of the Pawtucket pumping engine is partly due to the high state of efficiency to which the routine firing and other details of management have been brought by Chief Engineer Walker's zeal and intelligence.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE new holder for the Citizens Gas Light Company, of Wakefield, Mass., will probably be completed by August 15th.

ADVICES from Rich Hill (Mo.), under date of June 28th are to the effect that the consolidation of the Rich Hill Water Works Company, the Rich Hill Light, Heat and Power Gas Company and the Rich Hill Electric Light Company was effected on that day, as a result of a joint meeting of the stockholders in the three named Companies. The controlling stock in the Water Company was owned by the Messrs. Garrison, of St. Louis, Mr. Thomas Irish was the principal factor in the Gas Company, while Francis J. Pilgrim represented the electric lighting interests. The paid-up capital stock in the new enterprise is $185,000, about one-half of which is held by Messrs. Little, Scott & Co., of St. Louis, under the terms of the merger. The balance is chiefly owned by Fort Scott (Kan.), Pittsburg (Kan.) and Rich Hill capitalists. At the meeting the following officers were chosen: President, Thomas Irish; Secretary and Treasurer, C. R. Walters; Superintendent, F. J. Pilgrim—all residents of Rich Hill. The title of the consolidated enterprise is that of the Rich Hill Water, Light and Fuel Company. The officers were empowered to erect a new steel stand pipe, to extend the water and gas mains, and to add to the generating capacity of the gas plant. The cost of these betterments will not fall short of $8,000.

COL. MALCOLM PETERS, Vice-President and Manager of the Brockton (Mass.) Gas Light Company, sails for Europe to-morrow.

AT the annual meeting of the Ishpeming (Mich.) Gas and Electric Light Company, the following officers were elected: President, Charles Merryweather; Vice-President, Fred. Braastad; Secretary and Treasurer, J. P. LaLonde; Directors, C. H. Hall, Fred. Braastad, Jno. Jones, W. H. Johnston, A. B. Miner, S. A. Mintz and J. P. LaLonde. Although this Company has been in operation but a short time, its business is already on a paying basis and its roll of consumers is constantly increasing. In fact important main extensions are to be made at once, which is the best possible evidence that the residents are satisfied with the quality of the lighting article supplied. At the meeting an informal discussion on the advisability of installing an electric light plant was had, the outcome of which was an understanding that no steps in such direction would be taken for the present.

SOME of the "pure air cranks" in the vicinity of the Montclair (Bloomfield, N. J.) Gas and Water Company's works has been insisting rather loudly of late that the gas plant was a menace to their health, because of the noxious odors emanating therefrom. Their protestations finally induced Inspector W. B. Corby, of the Bloomfield Board of Health, to make a thorough investigation of the works, and that gentleman subsequently reported that the condition of the works was a credit to those who carried them on. He assserts that every precaution is taken to prevent the operation of gas making from causing annoyance to anyone.

A NEW industry has been established at Roanoke, Va., in the shape of the recent organization at that place of the Salem Gas Heater Manufacturing Company, which, it is calculated, when the manufacturing plant has been fully developed, will be able to turn out 100 gas cooking and heating stoves per day. The capital stock is placed at $100,000. The following are the officers for the first year: President, Gen. W. Palmer, of Saltville, Va.; Vice-President, Col. A. M. Bowman, of Salem, Va.; Secretary and Treasurer, Capt. T. A. Roberts, of Salem, Va.; Directors, J. W. F. Allemong, Prof. J. T. Crabtree, W. M. Nelson, J. H. Palmer, R. H. Ligon, Col. R. H. Logan, T. I. Preston, and T. A. Bryan, of Salem, Va., A. B. Palmer, of Baltimore, Md., and the President and Vice-President.

THE Lawrence (Mass.) Gas Company *will* control the local Edison Illuminating Company, notwithstanding all rumors to the contrary. Further, the Gas Company dictated the terms of the contract.

MR. JAMES GARDNER, JR., in consequence of his pluck and enterprise, is getting his full share of the business plums that fall to the lot of suppliers of gas works fireclay goods. For instance, he has just completed, at the works of the Detroit (Mich.) Gas Company, 4 benches on the McIlhenny regenerative plan, and has a stack of 10 benches of the same type under way at the Northern Liberties works, Philadelphia. By the way, Mr. Gardner is the "sole representative for the McIlhenny regenerative benches" in this country.

TOWARDS the close of June, Alderman Ansley, of the Birmingham (Ala.) City Fathers, called the attention of the Board to the application of the Fuel Gas Company for the right to lay mains in the city. After a somewhat spirited debate the "right" was granted. The Company agrees to light and heat all the public buildings in the city as payment for the franchise. Is this another strike?

A CORRESPONDENT at La Crosse, Wis., writing under date of July 3d, says: "An interesting conflict between the local authorities and the Gas Company was decided here towards the close of last month. On Eighth and Ninth streets the gas mains run through the centers of the roadway, and their removal became necessary so that the city's sewer system might be completed on the original plans. The gas men insisted that the Council should perform the work of changing the gas mains at public expense, but the authorities demurred. Legal opinions were in great demand, and the upshot of the affair was that the Gas Company carried the day."

THE June term Grand Jury (F. Higgins, foreman) of this city, doubtless moved thereto by the volcanic disturbances that have been so frequent of late in the vicinity of Fulton street and Broadway, paid their respects to the "underground pipe systems" of the city in the following presentation: "From evidence presented to the Grand Jury, we find that the contiguity of steam, gas and water pipes, of sewers and electric subways in and under the roadbeds of our principal streets, is an evil which demands immediate relief. The uptearing of the pavements caused by the laying of these pipes and their frequent repairs are obstructions to travel and entail needless expense to the city. The overheating of the soil and the adjacent water pipes is destructive to pavements of asphalt, and makes Croton water unfit to drink. The saturation of the soil with poisonous gases and dirty fluids is damaging to health. The explosion of gases and the liability to explosion by steam are constant menaces to life and limb. These evils have increased from year to year, and will continue to increase unless some remedy is found. As a present remedy we suggest that steam and gas companies be held to

strict accountability for all damages occasioned by their neglect, that penalties be rigidly enforced against companies that delay repairs and obstruct travel, that no more permits be granted for the laying of additional steam and gas pipes in streets that are now overcrowded. As a future remedy we suggest the appointment by the proper authorities of a commission of strictly non-political experts who shall consider the feasibility of vesting the management of street paving and of all underground pipes and sewers, and of devising a new system by which the benefits of steam, gas, water, electricity and sewage can be had more safely, and with less official obstructions."

On the morning of July 3d, Concord, N. H., was the scene of a conflagration that resulted in the destruction of $75,000 worth of real and personal property. One of the sufferers was the Concord Gas Company, the electric station of which was badly damaged by fire and water.

W. J. Flanigan, City Clerk of Binghampton, N. Y., informs us that the city will maintain 135 public arc lights on its streets as a portion of the public lighting service for the ensuing year.

The public lighting of Grand Rapids, Mich.,—that is, in respect to the number of gas, gasoline and naphtha lamps employed—costs, complete, $21,849.20. In the total, the respective charge per lamp per month figures out at: Gas, $1, gasoline, $1.33; naphtha, 45 cents. The lighting service is carried out under a decidedly mixed moontable.

Governor Brackett, of Massachusetts, has vetoed the bill permitting the consolidation in that State of gas and electric light companies, and the Senate (by a vote of 34 to 3) subsequently sustained the veto. The following is the substance of the Governor's veto message:

The bill allows the consolidation of both gas and electric companies and of two or more gas companies in the same city or town. The union of a gas company with one or more electric light companies can now be readily effected under the provisions of ch. 385 of the acts of 1887. This has already been done in many towns and cities. The gas company, when authorized by the Board of Gas and Electric Light Commissioners to engage in the business of furnishing electricity, has the right to purchase or lease the electric property and franchises then in use in its territory.

If the consolidation of gas and electric light companies is to be authorized by a general law, the exercise of this authority in every case should be made subject to the approval of some competent tribunal, whose duty it should be to consider the effect of the proposed consolidation upon the interests of the public. A union of companies in one town or city might be for the advantage of the people, but have the reverse effect in another, and the question is whether it should not be left to the determination alone of the stockholders of the consolidating companies, who would naturally make their own interests paramount to those of the public.

No such safeguard is provided by the bill. While it appears to give the Board of Gas and Electric Light Commissioners some supervision, it gives that Board no authority to pass upon the expediency of the consolidation. It simply provides that the Board shall render an opinion as to whether the provisions of the act have been complied with, and even this slight duty is to be performed at a stage of the proceedings when only a portion of the powers given by the act have been exercised. The advisability of a union of companies in any town or city presents a question which the Board above named ought to be peculiarly qualified to consider and determine, and the authority so to do should, in my opinion, be given to it if the bill is to be enacted.

It is obvious that the bill, if it becomes law, will make a radical change in the existing policy of the Commonwealth in relation to the capital stock of such corporations, the manner in which it be increased, and in which the shares shall be issued and paid for.

My chief objections to the bill relate to the restrictions in regard to the amount of stock which may be issued by the new company. These in my opinion are widely inadequate. There are two limitations. First, the capital shall not exceed by more than 25 per cent. the aggregate capital stock of the constituted companies authorized at the time of consolidation. It shall not exceed "the fair cash valuation of the shares of the constitutent companies issued and outstanding at the time of consolidation, as estimated by the tax commission for Massachusetts of taxation on the 1st day of May next preceding such consolidation.

The first limit practically places no bar to the most reckless issue of stock. It not only permits, but seems to invite it. The words "authorized at the time of consolidation" would allow the full amount of stock which the constituent companies in any event might issue under the Public Statutes, or under the special charters of the committees. Any gas company created by special charter prior to March 22, 1871, may increase its capital stock to an amount not exceeding $1,000,000. Nearly all the larger gas companies in the State were chartered prior to that date. Each of the electric light companies organized under the general law may also increase its capital stock to a like amount. This bill allows a further increase of 25 per cent. over these amounts, and does not require any additional money representing the additional capital stock to be paid into the treasury for the use of the new corporation.

The inflation possible within the meaning of the clause "authorized at the time of consolidation," is forcibly illustrated by reference to the gas and electric companies in the city of Boston, the following tabulation showing the present capital, the authorized capital and the possible increase:

	Present Capital.	Authorized Capital.
Boston Gas Light Co	$2,500,000	$3,500,000
Dorchester Gas Light Co	400,000	1,000,000
Charlestown Gas Light Co	500,000	1,000,000
East Boston Gas Light Co	220,000	1,000,000
Jamaica Plain Gas Light Co	200,000	1,000,000
Roxbury Gas Light Co	600,000	1,000,000
South Boston Gas Light Co	440,000	1,000,000
Bay State Gas Light Co	500,000	2,500,000
Total	$5,360,000	$12,000,000
Boston Electric Light Companies.		
Boston Electric Light Co	$1,000,000	$3,000,000
Edison Electric Illuminating Co	500,000	2,000,000
Total	$1,500,000	$5,000,000
Recapitulation.		
Gas companies' authorized capital		12,000,000
Electric light companies' capital		5,000,000
Total authorized capital		$17,000,000
Add 25 per cent.		4,250,000
Total authorized capital under the limitation		$21,250,000
Gas companies' present capital		5,360,000
Electric light companies' present capital		1,500,000
Total		6,860,000
Possible increase by the act over the present capital		$14,390,000

But these figures, large as they are, do not represent the full extent of the inflation possible under this limitation. They only represent the amount in the event that all the companies were consolidated at the same time. This need not be done, however. Two of them might unite and the new company formed by this union afterward unite with a third, and so on. Upon the first consolidation the authorized capital of the new company would be the aggregate of the capital of the consolidated companies with 25 per cent. thereof added. When the new company came to unite with the third company this authorized capital would be added to that of the third, and the amount might be further increased by the addition of 25 per cent. thereof. In other words, at each consolidation 25 per cent. of the sum of the authorized capital of the combining companies might be added, so that when all were finally united, the increase of the capital of the consolidated company over the present actual capitals of the companies named might be far in excess of the $14,390,000. Doubtless the intention to proceed in this way would be disclaimed by the parties interested in the bill; but in enacting it it is important to consider possibilities as well as present intentions.

The second limit is scarcely less objectionable, in my opinion, than the first. The valuation of the shares by the tax commissioner for the purposes of taxation ought not to form the basis of the capital stock. By ch. 13 of the Public Statutes it is provided that the tax commissioner shall ascertain from the returns or otherwise the true market value of the shares, and shall estimate therefrom the fair cash valuation of all of such shares on the 1st day of May next preceding, which shall be taken as the true value of the corporate franchise for the purpose of the charter.

The basis for the issue of stock should be uniform among the companies, and should be fixed as far as possible by the necessary outlay in the acquisition of real and taxable property. Companies which combine ought not, in this respect, to have an advantage over those which remain separate.

The result of such legislation elsewhere is instructive on this point. In the State of New York the law formerly provided that when two or more companies consolidated the capital stock of the new company should not exceed the aggregate amount of the capital of the consolid-

ating companies. In 1884 this law was changed so as to allow the capital of the new company to equal in amount the fair aggregate value of the property, franchises and rights of the consolidating companies. Under this statute the gas companies of the city of New York consolidated.

The New York Gas Company, in entering the consolidation, raised its capital stock from $4,000,000 to $7,560,000; the Manhattan from $4,000,000 to $11,940,000, the Metropolitan from $2,500,000 to $6,500,000. The other companies did the same, so that their aggregate capital, which before consolidation amounted to $17,000,000, was increased by the consolidation to $39,078,000, or more than 100 per cent. The result was that the people of New York city were obliged to pay dividends upon more than double the capital stock on which they had previously paid.

I cannot give my sanction to an act upon which a similar charge by the gas consumers may hereafter be founded.

THE Simcoe (Ont.) Gas and Water Company has been incorporated under the Dominion Acts regulating such enterprises. Simcoe is the capital seat of Norfolk County, Ontario, and is pleasantly located on the river Lynn, which at that point is quite an imposing stream. It is also on the line of the Great Western Railway, at a point 8 miles above Lake Erie. The population is about 5,300, and the town boasts of several manufacturing establishments—notably, in cast iron and mill machinery, leather and woolen goods, etc. A gas and water company ought to do well there.

THE Laclede Gas Light Company notifies the residents of St. Louis that, having purchased the works and street mains of the old Water Gas Company, for the purpose of utilizing the same in the direction of supplying fuel gas, in consequence of the necessary changes having been made, it is now ready to distribute a "thoroughly good fuel gas" to all parties on the line of the water gas mains, the rate for such service to be 40 cents per 1,000 cubic feet. The fuel gas mains will be extended as rapidly as the demand for the gas warrants.

THE proprietors of the Port Henry (N. Y.) Gas Company are installing a new McKenzie plant. It is proposed to put the selling rate at $2 per 1,000.

SPECIAL meetings of the stockholders of the Municipal Gas Light Company (Rochester, N. Y,) and of the Rochester Gas Light Company have been called for the 30th inst., for the purpose of approving an agreement entered into between the respective Boards of Directors for the consolidation of the Companies. Transfer books close to-morrow, to be re opened on August 1st.

HAVING heard a rumor to the effect that the Louisville (Ky.) Gas Light Company was likely to be purchased by an "English syndicate," Director John M. Atherton (who can be said to be one of the cleverest men in the State) was appealed to for information respecting the measure of truth in the assertion. Mr. Atherton's response was: "I don't think there is anything in the talk about an English syndicate trying to buy a controlling interest in the Gas Company's stock, though such a thing might be done and the directors know nothing of it until the time to make the transfer on the books of the company. I have not heard even an intimation of such a thing. The stock might be bought, you know, if it could be gotten together, but there are no large blocks of stock. It is generally scattered. No one man, under the law, can hold more than $100,000 worth, and there is but one block of that size held; that is by the Bustard heirs, who live in England. The city owns $925,000 worth of stock, but it is forbidden by law to sell it. The total amount of stock is about $2,570,000, but it is held by a good many people. I don't think there is anything in it. Oh, these things are frequently originated by promoters, who get options on property and take a gambler's chance on selling and making a commission. The English have invested a good deal of money in breweries and the like, but they haven't done anything in that line recently. Besides, money is working close in London now, and that has a tendency to check speculations such as these. Promoters and cheap money are usually at the bottom of these schemes, but when money is close, as it is now, the business is checked. I don't think you need pursue your investigations any further. I am satisfied there is nothing in the rumor."

THE Chicago *Mail*, of 5th inst., says that Geo. S. Poppers, a furniture dealer at No. 267 West Madison street, Chicago, has begun suit for $20,000, in an action for trespass against the Peoples Gas Light and Coke Company, who caused his gas supply to be shut off for several weeks. Complainant and the Company had a dispute as to the proper amount due on account of the gas service, the difference between them amounting to something like $25. Poppers refused to pay the sum demanded by the Company, whereupon, according to his recital of the circumstances, the Company, instead of removing the meter, tore up the street in front of his place of business, and took up the service pipe. He had to resort to kerosene for illumination, and claims that his business was thereby damaged in the sum of $20,000. The Company's defense is misstatement of facts by plaintiff.

THE Ventura (Cal.) Gas Light Company has engaged in the supply of electric lighting.

CONTRACTOR JOHN CHANDLER, of Plainfield, N. J., has brought suit against the Plainfield Electric Light Company, to recover the value of his trotting horse "Rambo," whose death was caused by contact with a live wire, trailing on Crescent avenue, while the animal was being driven home, by his owner, from the race track.

AT the regular annual meeting of the Long Branch (N. J.) Gas Company the following officers were elected: Presiden', H. E. Gawtry; Vice President, Samuel N. Janes; Treasurer, Geo. N. Curtis; Secretary, C. H. Irwin; Superintendent, Chas. J. Luther; Directors, H. E. Gawtry, Samuel N. Janes, Geo. N. Curtis, Geo. F. Baker and Jacob Steinbach.

MR. JOHN COLLINS, formerly Superintendent of the East Albany (N. Y.) Gas Company, has been appointed Superintendent of the Fishkill (N. Y.) Company.

THE Laclede Gas Company will build a works on the Pintsch plan to furnish gas for the railway cars that arrive and depart from the Union Depot in that city. Bids for the work have been advertised for.

AT the annual meeting of the Milwaukee (Wis,) Gas Company the following Directors were chosen: E. H. Brodhead, J. L. Mitchell, T. A. Greene, A. L. Cary, John Johnston, Elias Friend, J. E. Friend, Edward Dewey and John F. Cramer—the latter fills the vacancy occasioned by the death of Mr. H. H. Button. The officers chosen were: President, John L. Mitchell; Vice-President, T. A. Greene; Secretary, Gerard Kremer.

Steel for Water and Other Pipes.

Engineering says that steel for the manufacture of pipes is destined to become a great outlet for this metal, and substantial progress towards its adoption has been made this year. Mr. James Riley, one of our foremost engineers more distinctly associated with steel construction, has been making efforts of a more or less tentative character, to secure the adoption of this metal for the purpose, and to overcome the objection which has been raised to its use. The only technical difficulty was that of welding the tubes, and this he has overcome; but it is not so easy to fight down the prejudices against steel for tubes. Some time ago Messrs. A. & J. Stewart, Glasgow, and the Steel Company of Scotland, in conjunction, supplied tubes of steel for carrying the water over the Tay Bridge, this being the first illustration of their use in great Britain. These pipes were welded by Messrs. Stewart, and were fitted with Riley's patent socket, and completed by the Steel Company. They have proved very satisfactory. Tenders have been put in recently for 1,600 tons of steel water mains of large size for the Sydney Water Works. Estimates and tenders have been made within the last year or two for several very large quantities, requiring from 100,000 to 150,000 tons of steel; but as was the case on the introduction of steel for ship construction, the progress is very slow. When the strength of steel is contrasted with that of cast iron, of which those large water mains are usually constructed, it will be at once apparent that a great reduction can be made in the thickness and consequent weight of the metal required for the purpose. For conveyance abroad, too, the question of freight is a consideration. As an indication of this it may be mentioned that in a contract now in course of execution, the material for which is supplied by one of the steel companies in Scotland, for 20 miles of water main for Mexico, the sheets are not more than one-tenth of an inch in thickness. The fear of corrosion is not shared in by the engineers of this scheme, for having had experience for a number of years of the behavior of wrought iron for this purpose, they have had no hesitation in adopting the stronger and better metal steel. This main for Mexico is rivetted—for such thin sheets cannot well be welded—and the connections are the same as those used in the Tay Bridge pipe. It is under contemplation to make provision in the west of Scotland for executing contracts for steel piping at a more rapid rate than is now possible.

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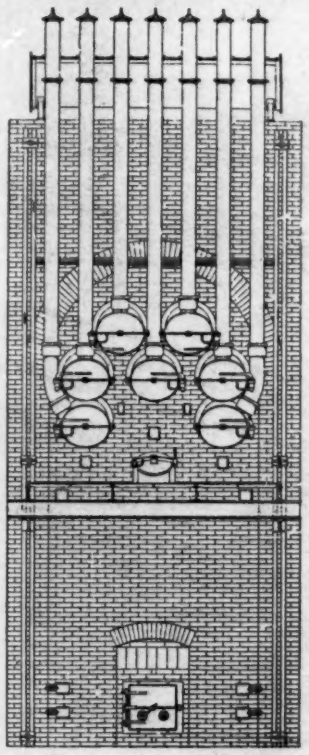

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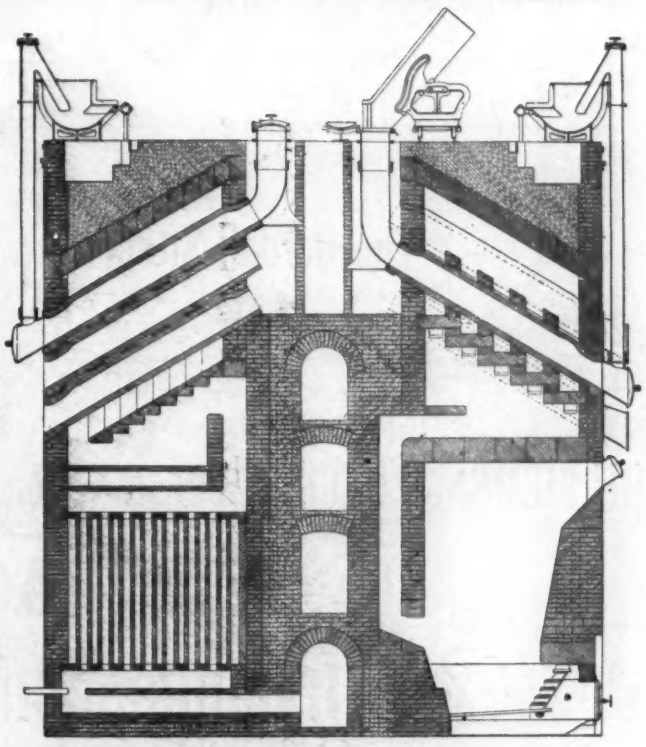

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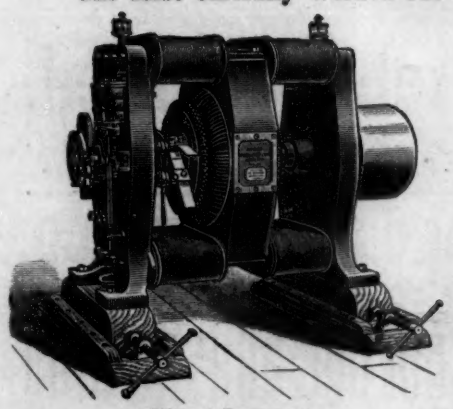

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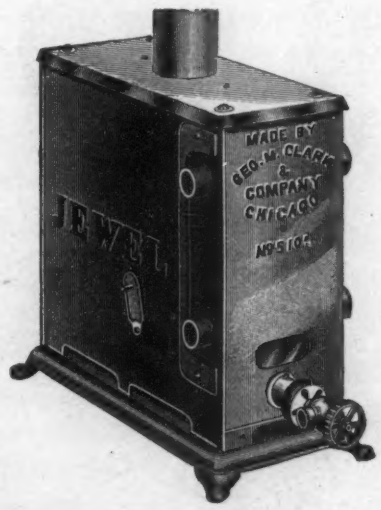

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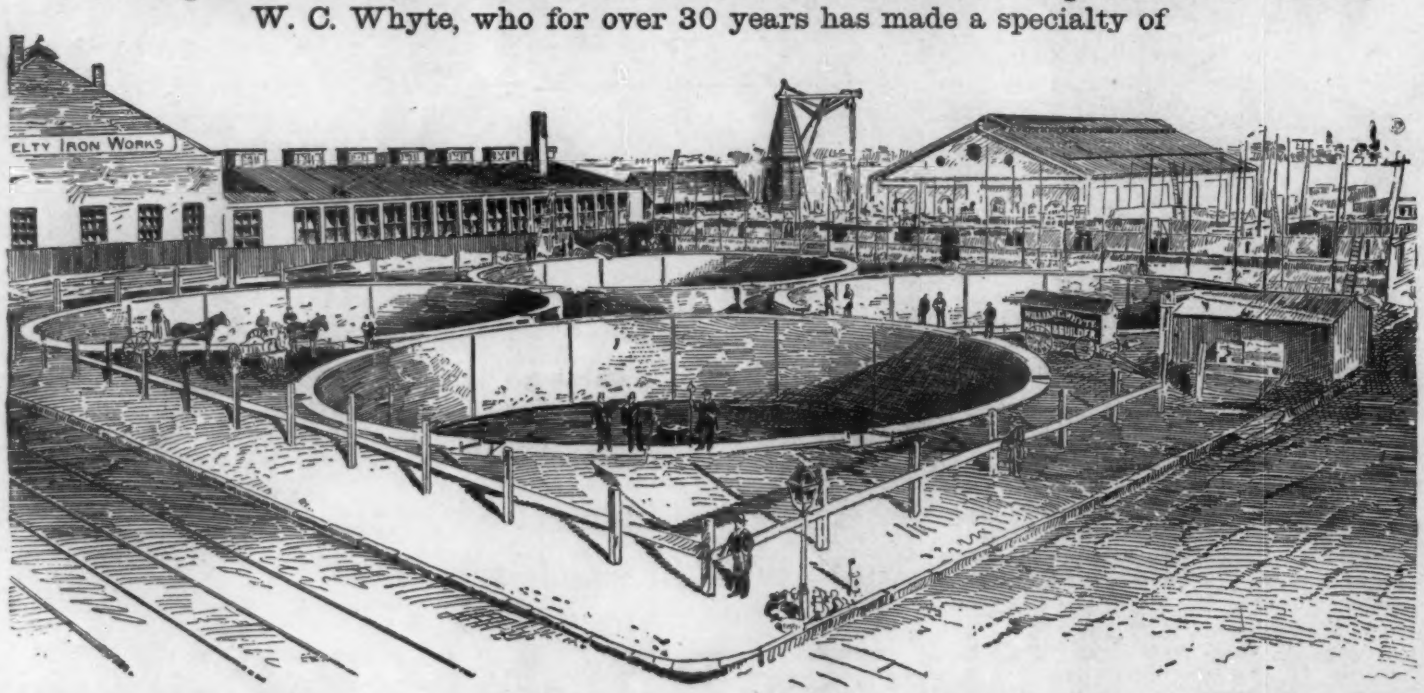

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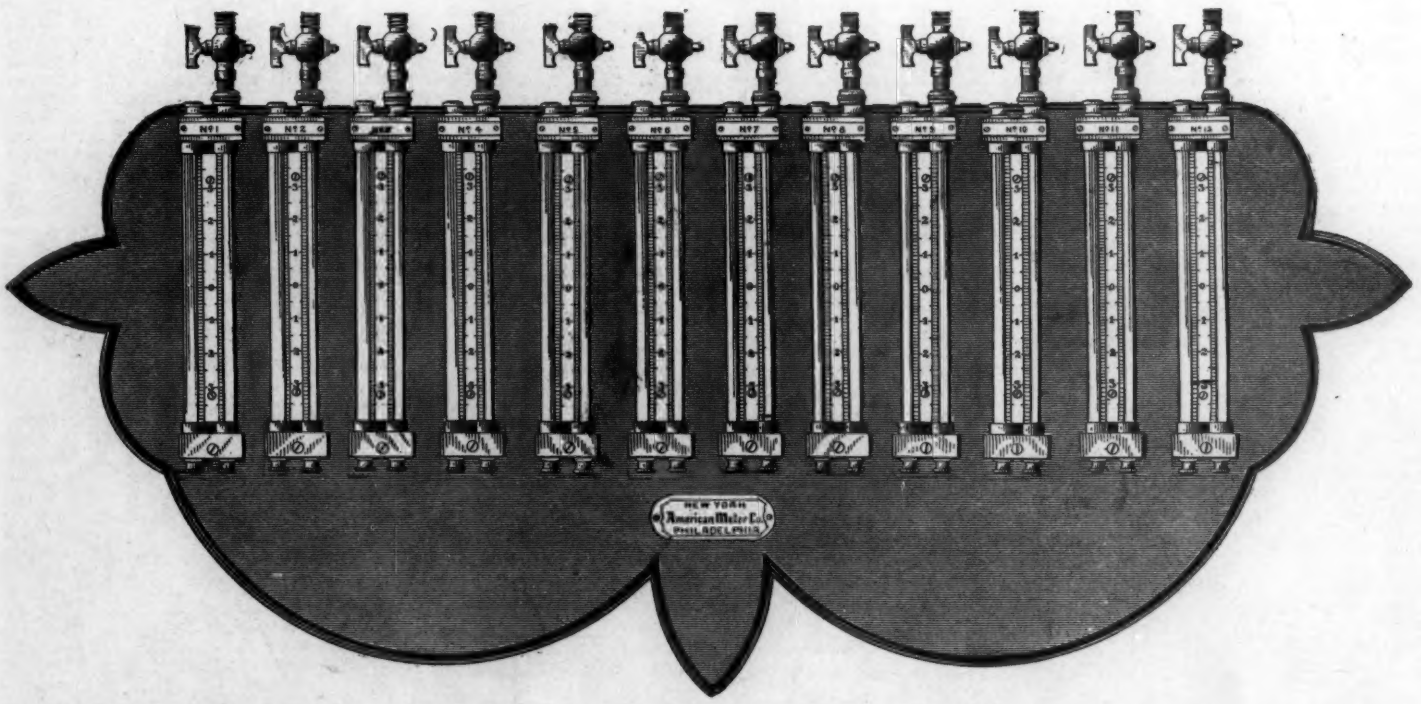

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Buffalo, U.S.A., Mutual	750,000
" Citizen	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" Nassau	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Donai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusseldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z.	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W.	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	200,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

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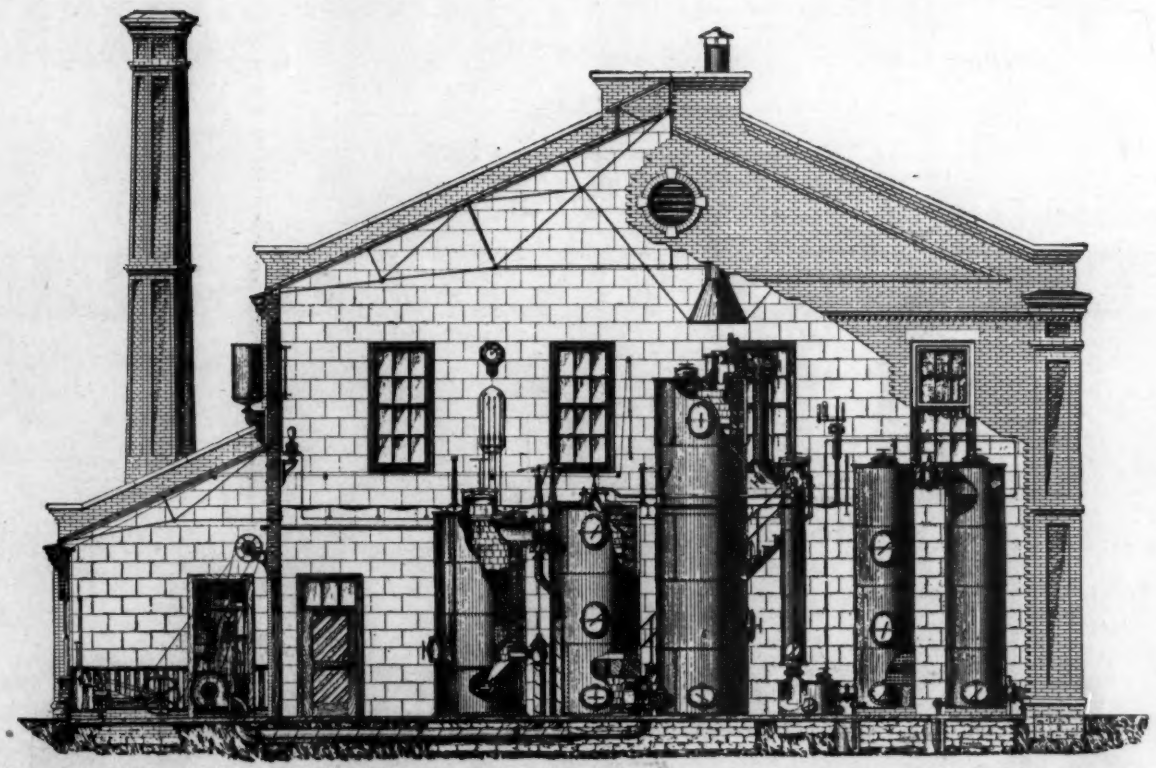

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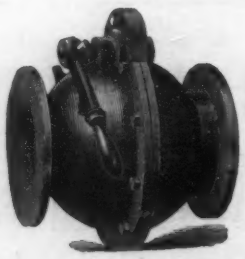

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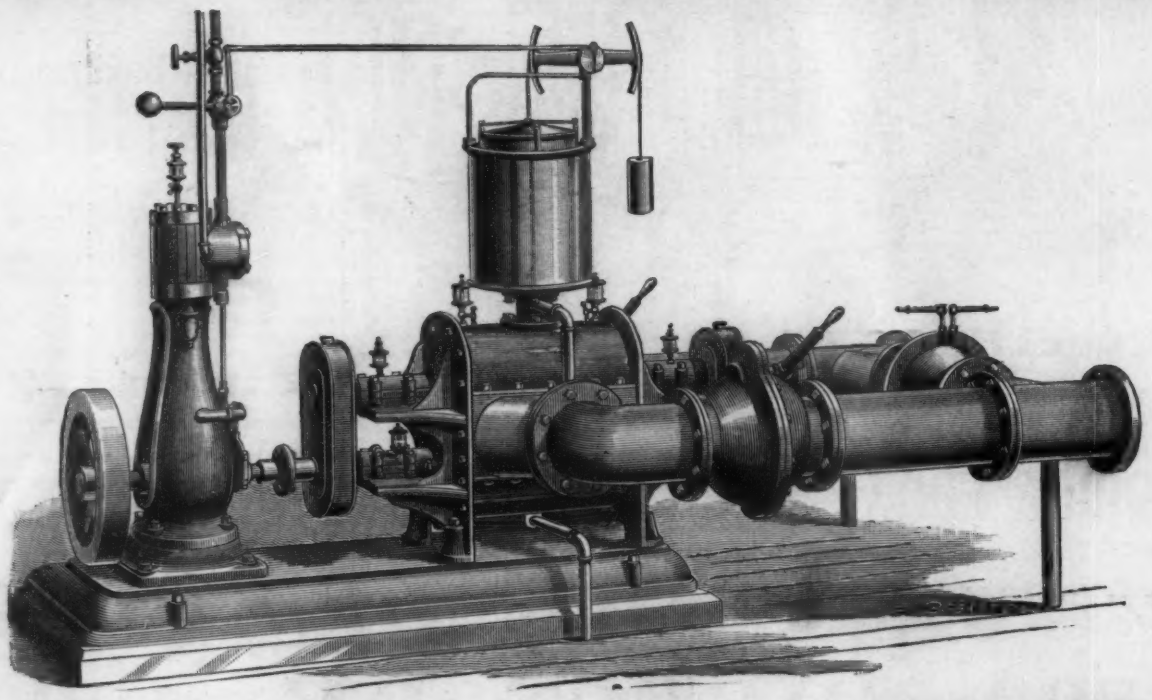

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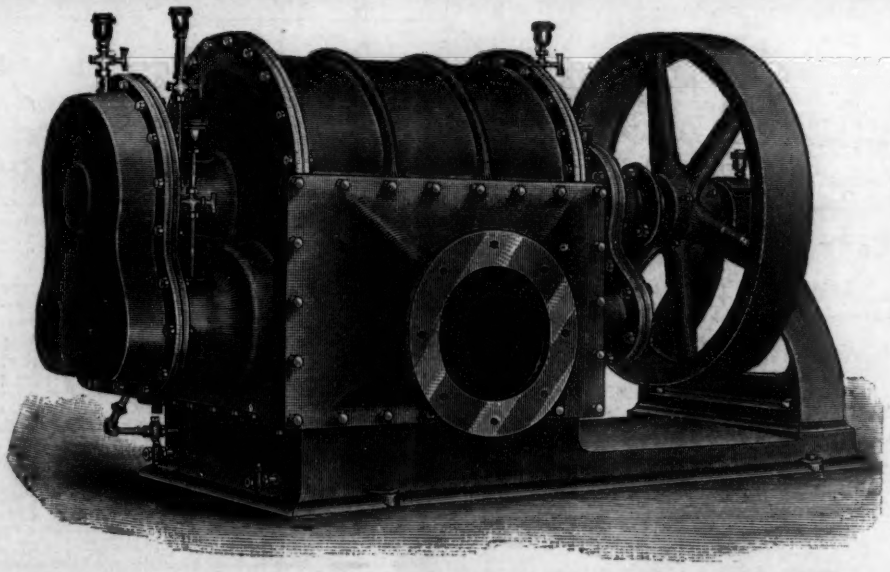

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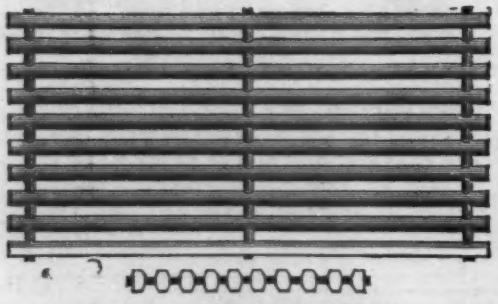

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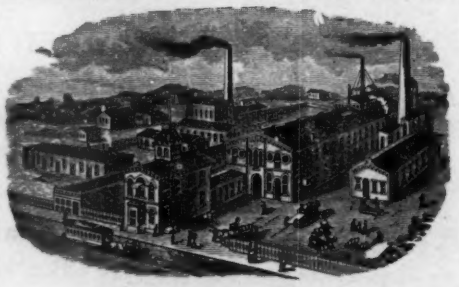

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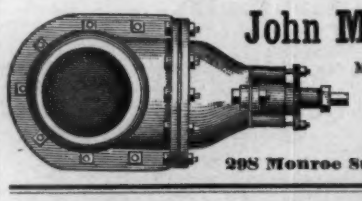

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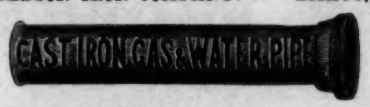

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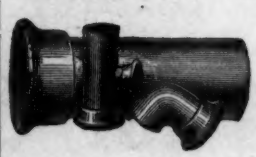

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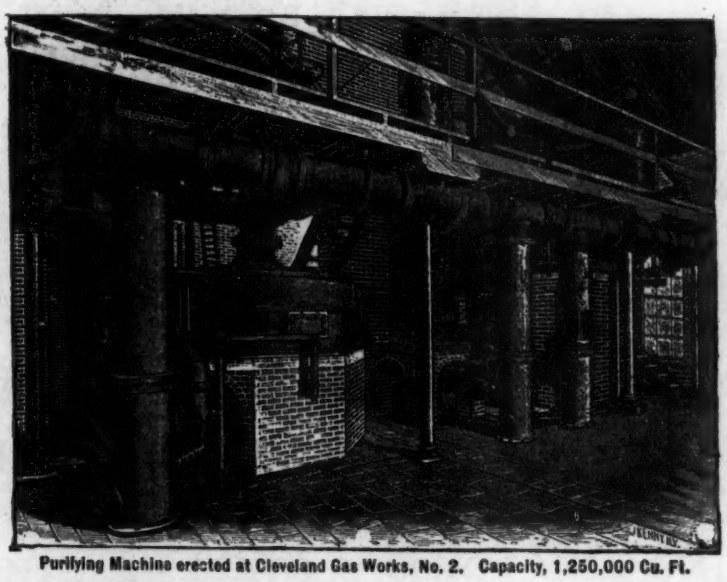

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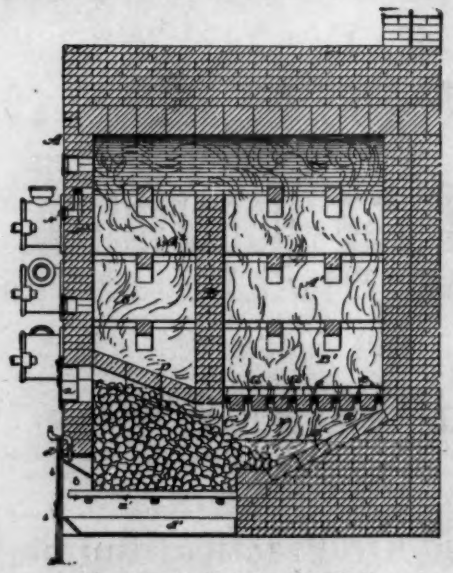

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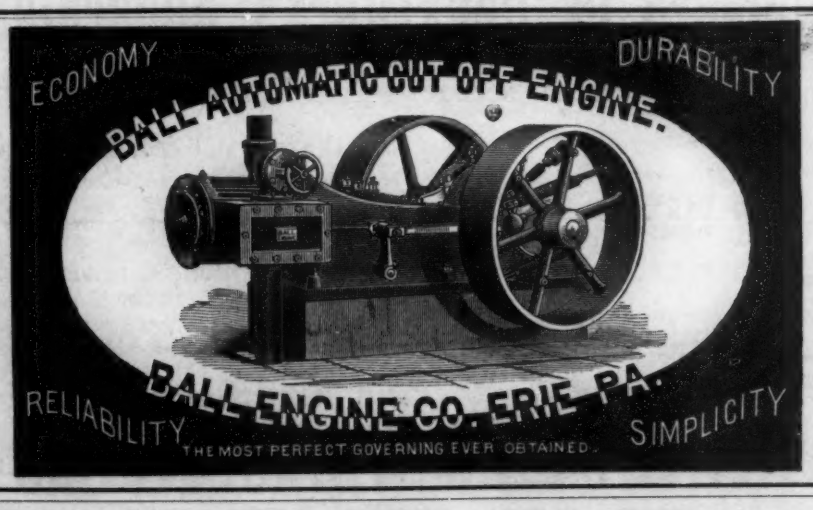

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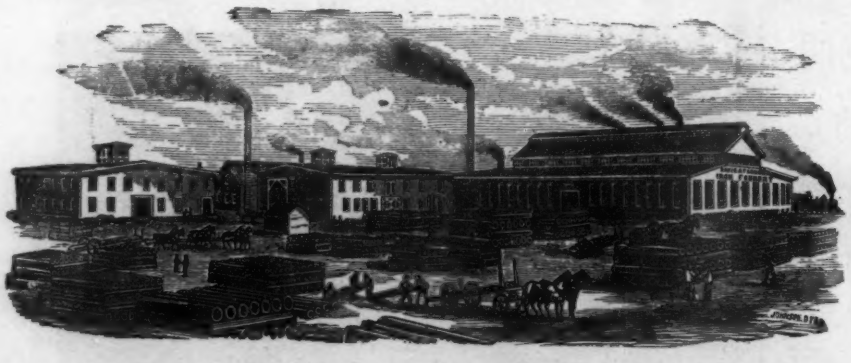

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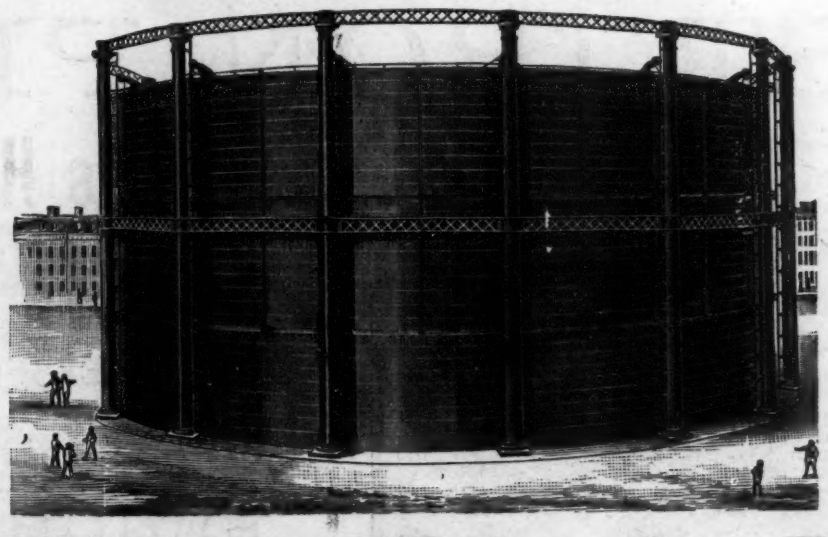

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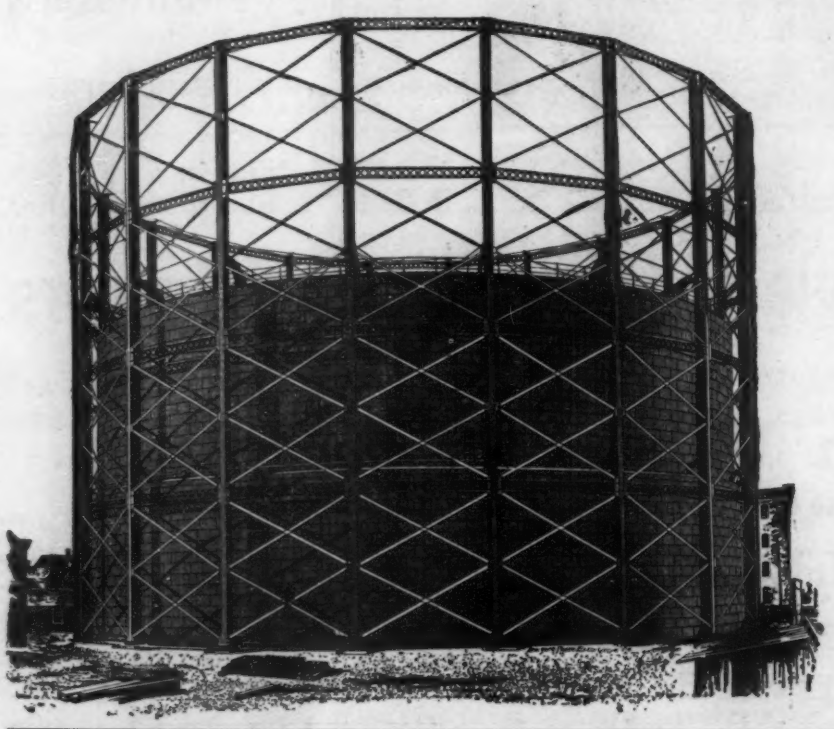

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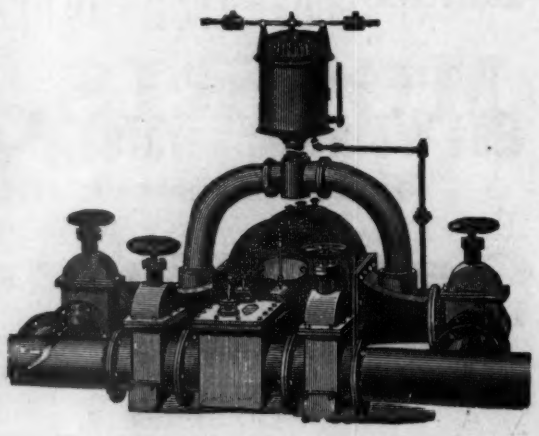

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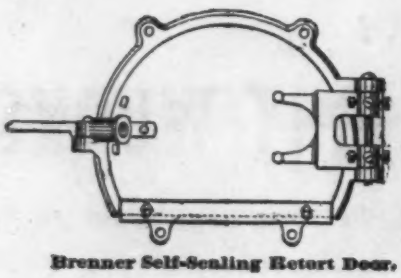

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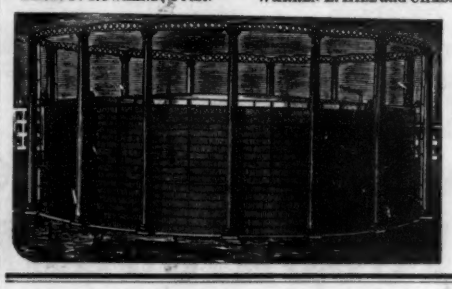
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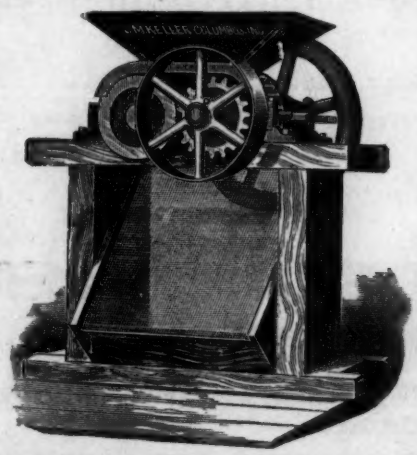

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High Pressure Meters for Natural Gas, in Iron Cases, guaranteed to stand 300 lbs. Pressure. Gas Cooking and Heating Stoves, Hot Plates, Cake Griddles, Waffle Bakers, Boiling Stoves, Laundry and Tailors' Iron Heaters. Hotel and Cafe Ranges a Specialty.

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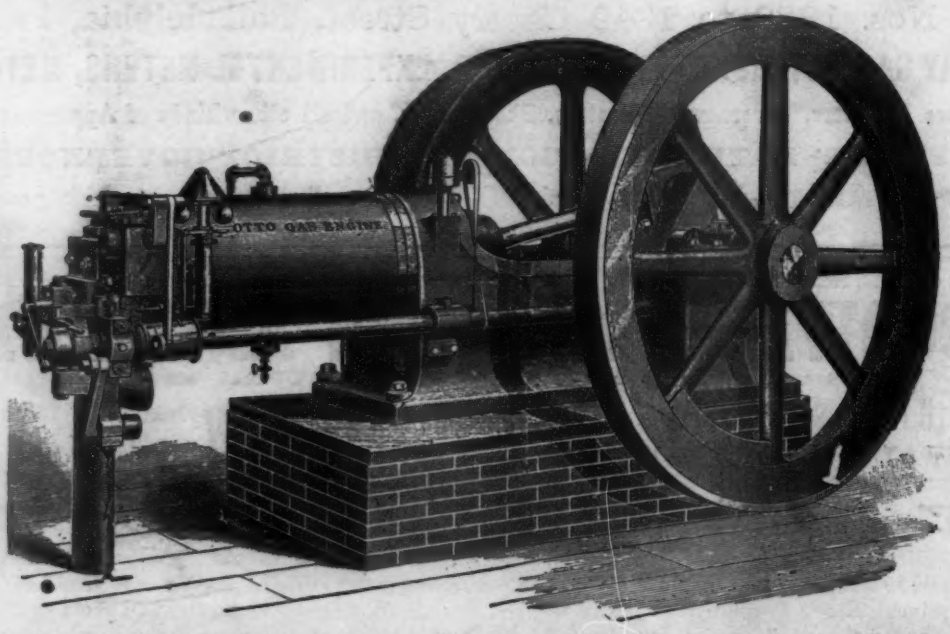

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Where Gas Companies adopt Gas Power for Electric Plants, Water Works, Sewerage, etc., they not only choose **the most economical power for their use,** but secure to themselves the **numerous advantages of increased production,** without increase of expense, and benefit thereby their entire manufacture. They induce consumers, by their example, to abandon Steam for Gas Power, and, by establishing special rates, make

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